Water spectrum

WINTER 1975-76

Water spectrum

Published Quarterly Vol. 7, No. 4, Winter 1975-76

Secretary of the Army
Martin Hoffmann

Assistant Secretary of the Army for Civil Works
Victor V. Veysey

Chief of Engineers
Lt. Gen. W. C. Gribble, Jr.

Director of Civil Works
Maj. Gen. Ernest Graves

Editor
Seymour Reitman

Editorial Assistant
Jill Pontius

A Director of Many Parts 1
by Seymour Reitman

Mitigation Can't Wait 7
by John L. McKern

Beneath The Tenn-Tom 17
by John Van Brahana

Treeing The Issues 25
by David E. Wojick, Ph.D.

PIANC 30
by Carl H. Bronn

The Face Behind the Falls 37
by Herbert C. Force

Events, Deeds & Deliberations 42

Comments on topics in this publication are invited. Send to:
Editor, Water Spectrum
Office, Chief of Engineers
Department of the Army
Washington, D.C. 20314

Letters to authors c/o Editor will be forwarded.

Use of funds for printing this quarterly publication was approved by the Director of the Office of Management and Budget on January 6, 1972, with approval to publish through December 31, 1976.

A major purpose of this publication is to serve as a written forum for the open discussion of issues and choices in resolving water resource problems. Views and conclusions expressed or implied do not necessarily reflect the position of the Corps of Engineers.

Subscription rate is $6.20 per year; $1.55 additional for foreign mailing. Price of a single copy is $1.55. Order directly from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

This issue developed by Office of Staffing and Management, Directorate of Civil Works.

Address changes: Please attach old address label to request for changes.

COVER: Displaced porcupine climbs tree to avoid rising reservoir waters before seeking higher ground farther up river, where mitigation areas will prohibit incursions on his new habitat. See page 7. Washington Dept. of Game

A DIRECTOR OF MANY PARTS

Major General Ernest Graves

by Seymour Reitman

The immediate future of the Civil Works Program of the U.S. Army Corps of Engineers lies in the hands of a new director: part civil engineer, part nuclear physicist. This hybrid background indicates that the man who now leads the Corps in meeting the Nation's water resource objectives is of more than one discipline, a man aware of the complex issues the Corps of the future faces. Beginning with a synopsis of his career, this article presents the thoughts of the new Director of Civil Works on the issues confronting the Corps today.

On September 22, 1975, Major General Ernest Graves fulfilled a lifelong dream, becoming Director of Civil Works in the Office of the Chief of Engineers. His father was an Engineer officer before him, with over 25 years of Civil Works duty in the Chief's office and the new director grew up hoping to follow in his father's military engineering footsteps.

General Graves remembers vividly from his boyhood the Engineer officers who were close associates of his father. One was Major Thomas B. Larkin, then a district engineer directing construction of the Fort Peck Dam on the upper Missouri River in northeastern Montana, later to become Quartermaster General of the Army. Another was Lieutenant Colonel John C. H. Lee, then Philadelphia District Engineer, who became commanding general of the European Communications Zone during World War II. Still another district engineer acquaintance of his boyhood days later commanded the Army Service Forces for the War Department during World War II. That was General Brehon B. Somervell. Among the officers who worked with his father in the Office of the Chief of Engineers were a Major Raymond A. Wheeler, who later became the 38th Chief of Engineers (1945-49) and a Lieutenant Leslie R. Groves, who directed development of the atomic bomb during World War II.

Whenever one of these men came to dinner, his father and guest would usually stay at the table after the meal to enjoy a drink of homemade wine and talk about their jobs. "I would sit in a chair against the wall listening to everything they said," recalled General Graves. "I wanted to be in the Army and work on Civil Works as far back as I can remember."

With models like these men, it is no wonder the younger Graves aspired to become a part of the Corps of Engineers, which he eventually joined on an auspicious day in military history. General Graves gradu-

ated from West Point and received his commission as a second lieutenant in the Corps of Engineers on D-Day, 1944. Following service as a combat engineer platoon leader in Europe until the summer of 1945, he redeployed with his unit to the Philippines in preparation for the invasion of Japan and spent nearly a year with the Army of Occupation in Yokohama.

In the fall of 1946 the Army transferred nearly 50 young Engineer officers from overseas to New Mexico, where they became part of the Manhattan Project. Among them was the newly promoted Captain Graves. The purpose behind this assignment was to help put the wartime atomic bomb development project on a peacetime footing. Selection for this unique duty was the beginning of a career in which his assignments alternated between nuclear energy and civil engineering.

From New Mexico Captain Graves went east to attend graduate school and in 1951 received his Ph.D. in physics from the Massachusetts Institute of Technology. While doing original research and preparing his dissertation on nuclear particles, he pursued a minor in civil engineering—an unusual combination, but one approved by his faculty committee as good preparation for a military engineering career.

After a tour in Paris at Supreme Headquarters Allied Powers Europe, where he worked on the NATO airfield construction program, General Graves spent 2 years at Fort Belvoir, Va., assembling and training the military operating crew for the Army's first nuclear power plant. Then, for nearly a year he commanded the 44th Engineer Construction Battalion in Korea, until his tour was cut short in the fall of 1959 when he was brought back to the United States to become a research associate at the Lawrence Radiation Laboratory in Livermore, Calif.

At that time President Eisenhower was seriously considering excavating a sea-level canal through the Isthmus of Panama with controlled nuclear explosions, and the then Major Graves was assigned to Livermore to learn as much as possible about this new tech-

Corps response to local interests ranges from public hearings to cleanup campaigns.

Right—A personnel development program insures maintenance of strong base of expertise and quality performance into the future.

nology and help plan the project. Except for a short stint as Los Angeles Deputy District Engineer in 1961, General Graves continued his close association with the sea-level canal project for the next 7 years. He spent one winter in Washington as part of a State Department study group before returning to Livermore to establish the U.S. Army Engineer Nuclear Cratering Group and serve as its first director. At the end of this period he was called upon to serve in the Office of the Under Secretary of the Army as the principal Department of Defense staff officer responsible for the conduct of canal treaty negotiations with Panama.

General Graves recalls that the complexity of the work on the sea-level canal project involved many disciplines, including those concerned with nuclear physics, civil engineering, economics and international relations. Of interest here is that the study of environmental impacts was also a major part of the sea-level canal investigations—a full decade before passage of NEPA, the National Environmental Policy Act of 1969.

"We were studying the *ecology* of the canal site when most people hadn't even heard of the word," noted General Graves. Besides introducing him to the importance of the environment, the canal assignment brought General Graves into official contact with the Civil Works Program for the first time in his military career. While in Livermore he reported directly to the Director of Civil Works, a position held, in turn, by Generals William F. Cassidy, Robert G. MacDonnell and Jackson Graham during this period.

After his duty with the Under Secretary, General Graves was named Executive to the Secretary of the Army, then sent to Vietnam to command the 34th Engineer Group in the Mekong Delta. On returning to the United States he became Deputy Director of Military Construction in the Office of the Chief of Engineers, followed by an assignment as President of the Air Defense Evaluation Board, also in Washington, D.C.

His next tour of duty moved him to Chicago and into his "main Civil Works job" prior to his present assignment. From December 1970 to December 1973 General Graves served as the North Central Division

There are regional environmental as well as navigational considerations involved in current controversy over Locks and Dam 26 modernization. The Corps must consider all aspects.

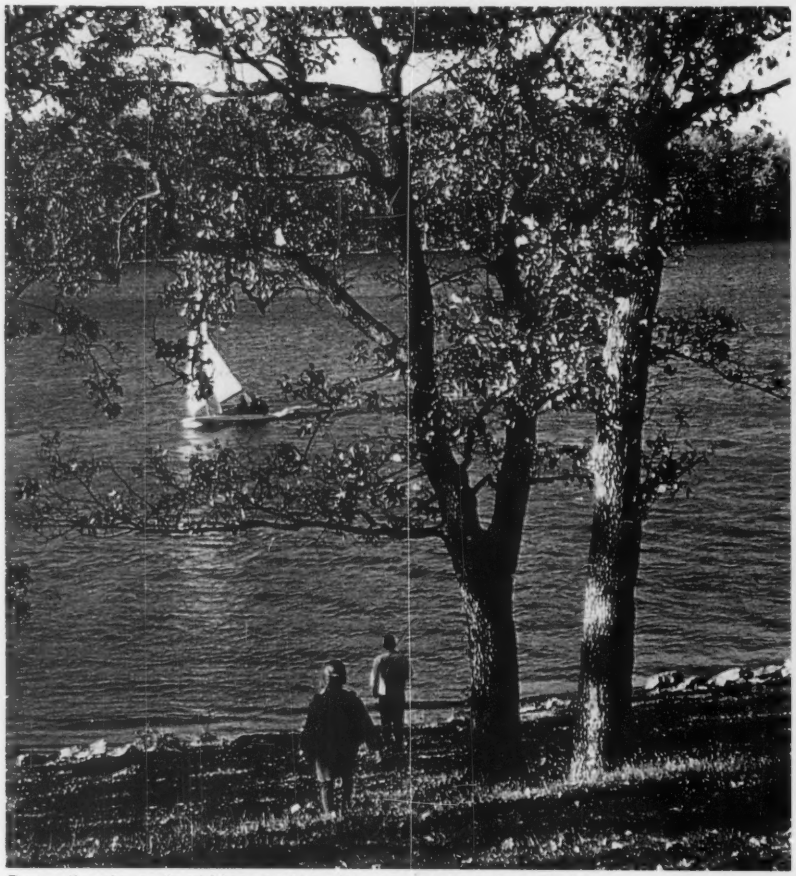
Engineer, responsible for the Corps' water resources program in the Great Lakes area, upper Mississippi Valley and the Souris, Red and Rainy River Basins in North Dakota and Minnesota.

"Coming right after the passage of NEPA, it was a very significant time for the Nation and for the Corps," recalled General Graves. "The North Central Division is a region with great environmental values, and the people have long appreciated and vigorously sought to preserve and enhance their natural environment. We in the Corps made a big leap forward in environmental sensitivity during those 3 years."

Following his tour as division engineer General Graves returned to the nuclear energy field in January 1974, serving as the Director of Military Application in the Energy Research and Development Administration (successor to the Atomic Energy Commission). It was from this job that he came to the Civil Works Directorate in September 1975.

Talking about his current work, General Graves stressed the following themes: responsiveness, communications, environmental sensitivity, personnel development and quality performance. He then proceeded to describe what each of them meant to him.

Throughout its 152-year history the Civil Works Program has been directed toward meeting the water resource needs of the people of the United States, he began. "The Corps listened to the local people as they expressed these needs, we analyzed their problems and formulated sound solutions, and we recommended to



Recreational use should be considered in every civil works project.

Congress the best way to meet the needs of the people."

One of the toughest challenges facing the Corps in today's complex society, General Graves continued, is to maintain this responsiveness by keeping in close touch with the people directly affected at the local level by the Civil Works Program. Part of that challenge is to "assure that our recommendations to Congress continue to respond to the true needs of the American people." Being responsive to local interests, he explained, means helping them think through their problems and reach decisions that will bring the best local solutions.

This concept expresses the rationale behind every Civil Works project, he added, which is to provide as many benefits as practical to the area affected by the project. Among the many benefits of modern resource development, General Graves stressed the importance of an imaginative recreation program.

The key to true responsiveness, declared the new Director, is improved communications—a vigorous dialogue between the Corps and both proponents and antagonists of a proposed project. "The more we communicate with and receive the views of others, the better job we will do in analyzing the Nation's water resource problems and recommending the future direction the United States should take," General Graves stated.

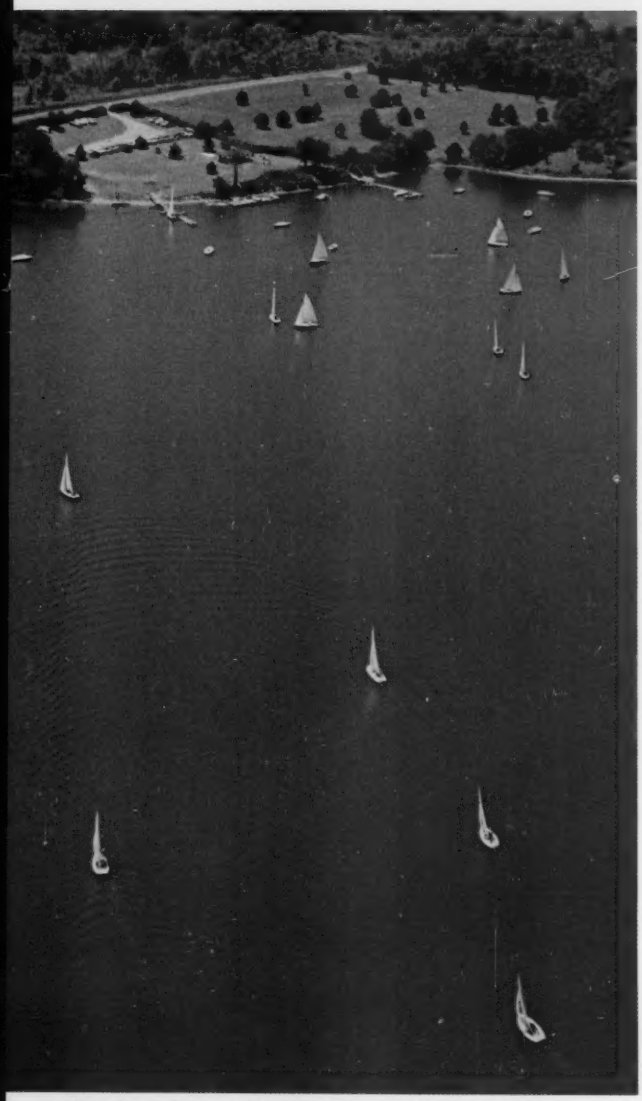
Another major concern is the preservation and enhancement of the environment for the benefit of future generations. General Graves emphasized that responding to this concern will require a high degree of environmental sensitivity on the part of the Corps. The emphasis during the last 150 years, he pointed out, has been on the Corps' contribution to the country's economic strength and general well-being through the planning, construction and operation of water resource projects. The Corps can be justly proud, General Graves remarked, of its role in helping to build the America of today and improving the quality of life for all of us.

The basic missions given the Corps by Congress are still important and contribute greatly to the underlying strength of the United States. These missions must be continued. The problem faced by our country, General Graves pointed out, is that the growth in population, capital investment and standard of living places increasing pressures on the environment. These pressures, in turn, endanger the Nation's ecological systems and natural resources. Preserving the environment and meeting the essential economic and social needs of society are equally essential to the future quality of life in the United States.

Citing the stalled Locks and Dam 26 project on the upper Mississippi as an example, he pointed out that the Corps, despite controversy, has to be sensitive to both sustaining a healthy inland navigation system and protecting the environment. Both concerns, General Graves explained, must be balanced in the quest for a better quality of life.

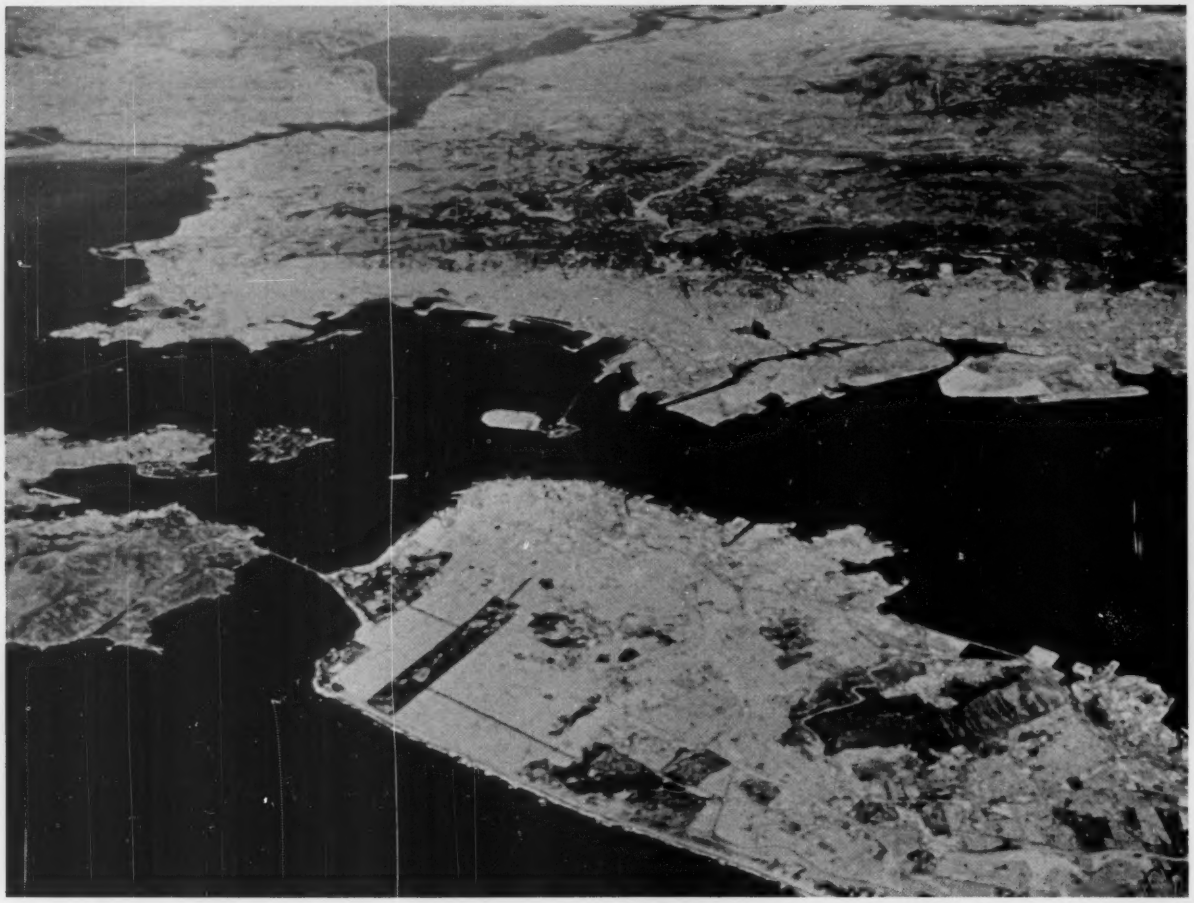
Reflecting on the quality of life, General Graves paused to point out that "our concern for people and the environment is reflected in the slogan: **The Corps Cares**."

Supporting the entire Civil Works effort, he continued, is the development of personnel, both military and civilian. General Graves hopes the Corps can build upon the strong base of expertise it already possesses by anticipating its personnel needs 10 to 15 years hence. To accomplish this objective will require two things: attracting capable young people and continuing to develop the talents of those already a part of the



The Corps has a definite role in improving quality of life.

Remote sensing, used in capturing this image of San Francisco Bay, is a technical tool which will provide the Corps with environmental data never before available.



Civil Works Program. This objective is closely related to the last theme General Graves discussed, that of quality performance.

He emphatically stated that the Corps must continue to strive for quality performance if it is to remain in the forefront of engineering.

From his long association with nuclear energy, the new Director of Civil Works brings a strong belief in the contribution of research and development to quality performance. Long a basic strength of the Corps research program is its in-house technical capability. This capability, he insists, must be retained at its present high level for the Corps to maintain its leadership in the development and conservation of our national water resources. Application of remote sensing to water resource planning is one example of improving performance through technology. Another is the investigation into the nature and beneficial uses of dredged material to improve our navigation program.

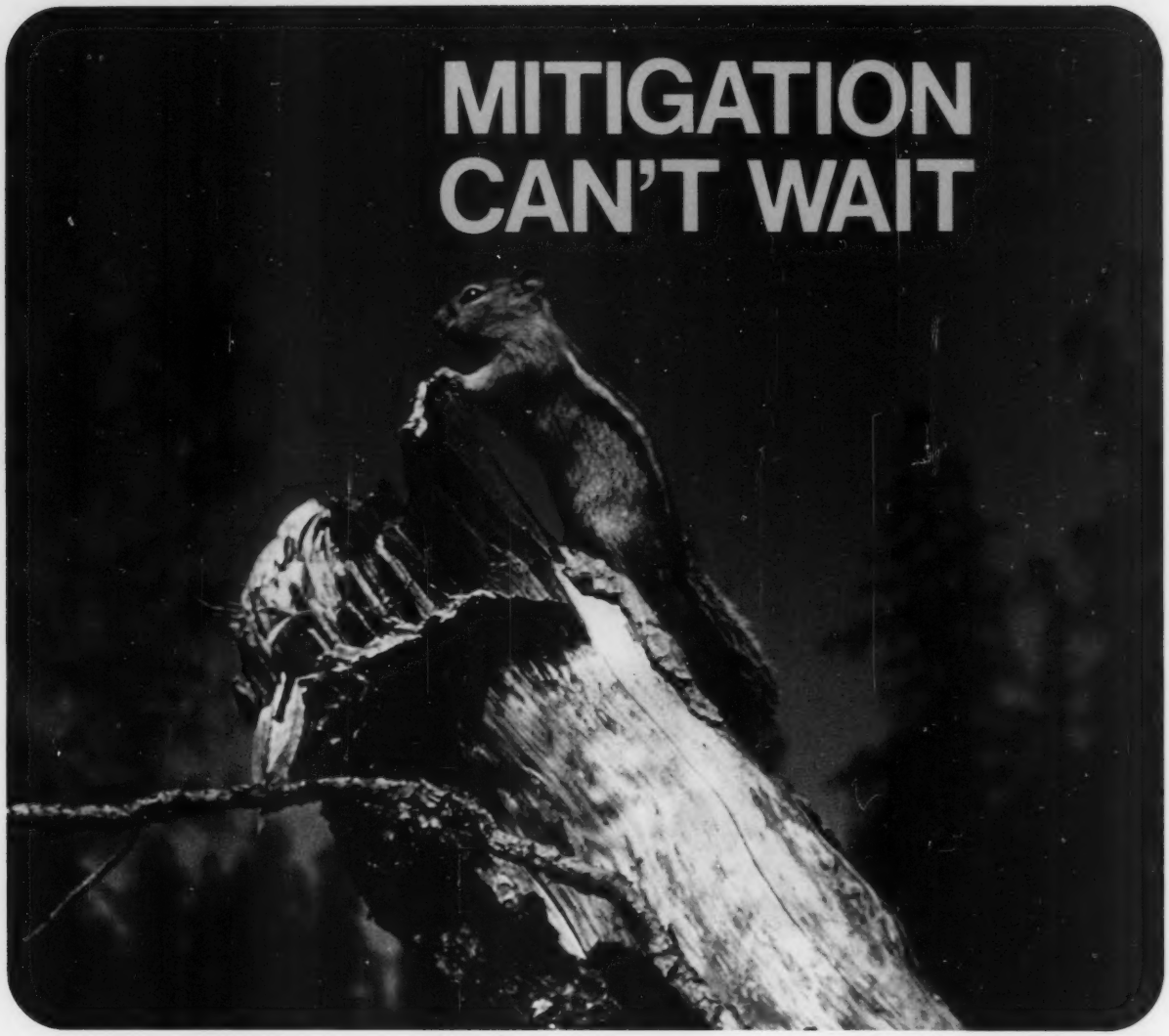
Quality performance, explained General Graves, also depends on sound management of resources. "In this period of competing demands for national resources the Corps must strive continuously to achieve the best results within the means provided it by the President and Congress."

Asked to collect his preceding thoughts into a succinct statement directed toward the Corps he would like to see tomorrow, General Graves responded by calling to mind "the exceptional sense of professional integrity and organizational pride we have derived from our long record of achievement. These qualities must be maintained if we are to communicate our goals to the public in a credible fashion and properly respond to the public's demands on us. The Corps, with its great technical capability, has a tremendous opportunity to contribute to the future well-being of the American people. Through innovative solutions to water resource problems we can assure a wise balance between the development of the Nation's resources and the preservation and enhancement of the environment."

General Graves expressed his conviction that the future work of the Corps will benefit our Nation just as much as the many Corps accomplishments of the past. "That," he declared, "is what we mean when our Corps people proclaim we are **Building Tomorrow Today**." ■

by John L. McKern
Fish & Wildlife Biologist
Walla Walla District, North Pacific Division

MITIGATION CAN'T WAIT



Rich in natural resources, abounding in fish and wildlife, the Pacific Northwest is a cornucopia of nature possessing a bountiful supply of water fed by mountain streams and glaciers pouring into mighty rivers that flow to the sea.

When one thinks of the Pacific Northwest, the huge Columbia River drainage system automatically comes to mind; yet there are numerous smaller river basins of consequence that receive the rains from Oregon's westside, Washington's Olympic Peninsula and the coastal mountains. Add the snowmelts from the western slopes of the Rockies, the mountain glaciers of Alaska, arctic icebergs, and the water resource available assumes a monumental scope.

The Corps, through its water resource projects, has long been a part of the Pacific Northwest's development. Beginning with completion of Bonneville Dam on the Columbia River in 1938 and culminating with completion of Lower Granite Lock and Dam on the lower Snake River in 1975, the Corps has constructed a world-famous 460-mile navigable waterway making Lewiston, Idaho into an inland seaport.

Such an extensive program of development has not been without its environmental problems. Creation of numerous slack water reservoirs along the main stems of the region's major rivers has exacted a toll in the resultant alteration of natural habitat for salmon, steelhead and many species of wildlife.

Riparian zones such as river bottoms are known for their high carrying capacity, and are usually able to support more wildlife than surrounding uplands. Since food, cover and water are primary elements of habitat,

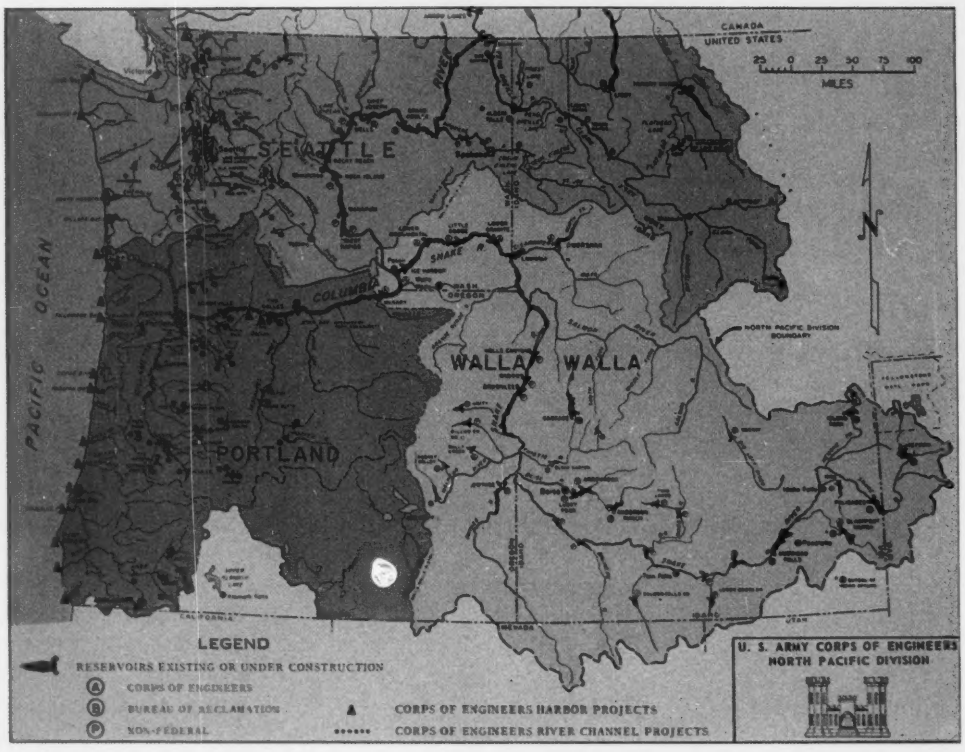
there is nearly always more vegetation providing the first two elements nearer the third—water. To determine just how good a given habitat is, it becomes necessary to include special factors in the assessment, such as the presence of minerals and salts and the influence of hunting, predation, starvation, disease, parasites and accidents.

All areas may be considered habitat, ranking from excellent to very poor. If we were to examine a cross section through the valley of a river flowing through semiarid land, we would find excellent habitat in the riparian zone at one extreme to very poor habitat on the arid ridge tops. In more temperate zones, riparian habitats may extend up the hillsides, with the quality dependent on the density and variety of the vegetative community. Therefore, inundation resulting from impounding stream flows behind dams eliminates the riparian habitats, with a pronounced impact upon the wildlife community.

Over 25 dams have been constructed within the geographical jurisdiction of the North Pacific Division for flood control, navigation and power generation. To select one as an example of the impact on wildlife, let us look at the recently completed Dworshak Dam placed at the foot of a canyon on the North Fork of the Clearwater River near Ahsahka, Idaho. The 717-foot-high dam created a 632-foot-deep reservoir extending 54 miles upstream, flooding more than 17,000 acres of land once considered excellent habitat. The North Fork basin extends from near the western Idaho boundary to the Idaho-Montana border, with most of the basin covered by the forested slopes of the Bitterroot Mountains. Forests at the upper end of the basin drop down to a wheatland plateau through which the North Fork cuts deeply as it flows into the Clearwater River within forested canyons.

Over 12,500 Rocky Mountain elk live in the North Fork drainage with lesser numbers of both mule and whitetail deer. There are also black bears, mountain lions, bobcats and a variety of furbearing and nongame mammals. Among the avian species are bald eagles, ospreys, blue and ruffed grouse and a variety of smaller birds. Herpetofauna—including snakes, lizards and amphibians—round out the wildlife community which finds the North Fork habitat suitable. Flooding of the North Fork canyon disturbed those species most dependent on land closest to the stream.

Representative of the resident animals that inhabit this general area are the black bear, marmot, squirrel, chipmunk and raccoon. These animals remain yearround in the same area by hibernating through the severe winters. The other species native to this area migrate to winter ranges. Most avian species migrate long distances in order to obtain a more suitable habitat



Above—Turnabout is fair play as meadow mouse prepares to nip nose of gopher snake made lethargic by cold weather as rising waters of Lower Granite pool drive predator and prey to new habitat.

Top—Good badger habitat requires an abundance of smaller resident prey.
U.S. Forest Service

Above left—Bald eagles winter at Lucky Peak Lake or Dworshak Reservoir and summer along Oregon and Washington coasts, but heaviest concentrations range from southeastern Alaska through Aleutian Islands.

Left—Yellow belly marmot resides in more limited habitat, prefering rocky terrain and talus slopes, and even calling riprap home at times.

as winter approaches. Deer and elk are somewhat akin to the birds in their migration habits, except that they do not travel as far.

North Fork elk find the slopes of the surrounding mountains an abundant summer range, but the greatly restricted winter range forces them to migrate into the lower canyon bottoms, where they eke out a subsistence on winter rations consisting of twigs from the redstem ceanothus, willow, serviceberry and other shrubs. The mule deer winter at higher elvations than the elk, but whitetails browse at even lower elevations.

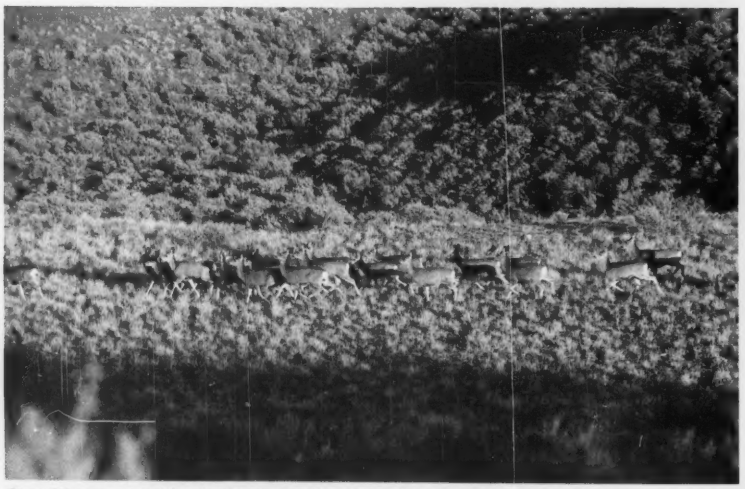
It becomes evident that while flooding of the lower elevations cost all the resident and migratory wildlife considerable permanent range areas, the whitetail deer were hardest hit; over 85 percent of this population lost its accustomed winter range. In place of timber and brush, the whitetails found the frozen surface of the new Dworshak Reservoir during the first winter of 1971-72. Now that the reservoir has filled, the water stores sufficient heat to prevent freezing. Nonetheless, 17,000 acres of winter range for deer and elk and permanent habitat for resident wildlife are gone.

In addition to the presence of dams, two other types of manmade activities affect wildlife in the Pacific Northwest; these are the construction of dikes and levees and dredging. Dikes and levees crowd the upper reaches of the Snake River into a restricted channel to protect the Jackson Hole, Wyo. residences along the banks. Once famous for wintering herds of elk, Jackson Hole is now a valley choked with ski resorts, condominiums and elaborate homes. Such activity results in annual reductions in the amount of riparian habitat remaining.

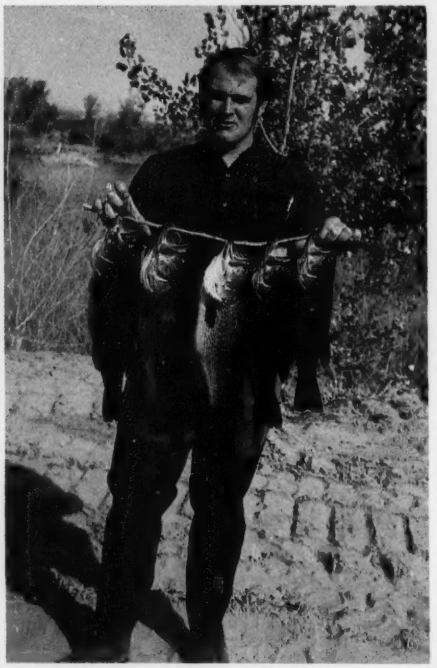
Dredging is necessary to maintain proper navigation depths in the many small harbors along the coasts of Oregon, Washington and Alaska, the major ports on the Columbia River estuary, Puget Sound and the inland waterway terminating at Lewiston, Idaho. Placement of the dredged material that results from this operation also reduces existing riparian and benthic habitat. Careful disposal practices, however, can create new habitat to replace that destroyed.

These are the major reasons why the concept of mitigation was introduced to counteract declining habitat for wildlife. Agencies with responsibility for developing water resources and managing wildlife resources are expected to coordinate planning and development of their respective project resources in order to replace and restore wildlife habitats lost through construction activities. Many early attempts at mitigating wildlife losses were unsuccessful because the necessary coordination among agencies was lacking.

Construction of the John Day Lock and Dam, the third one upstream on the Columbia River, resulted in the loss of many waterfowl production areas. A replacement 29,000-acre national wildlife refuge was established with the intent of not only mitigating lost waterfowl nesting sites, but also providing habitat for waterfowl migrants wintering in the area. Its very size would be large enough to attract 50 percent more use by water-



Over 50 percent of Lucky Peak Lake's project lands are now managed as mule deer winter range by Idaho Fish and Game Department.



Local mitigation projects like McNary Wildlife Park produce largemouth bass such as these.
Oregon Dept. of Fish & Wildlife

Snags deliberately left along reservoir shoreline provide nesting sites for ospreys.

fowl than the areas lost through inundation. Although the Corps has purchased the necessary land, subsequent development of this refuge by the U.S. Fish and Wildlife Service has been progressing at a minimal level.

The impacts on fish and wildlife resources caused by construction of the four dams known as the Lower Snake River Project[1] have been detailed in reports by the U.S. Fish and Wildlife Service and the Corps. This Lower Snake River Compensation Plan is being reviewed by the Chief of Engineers before submitting it to Congress for authorization.

Mitigation is starting this winter on the Dworshak Wildlife Compensation Plan following studies on the amount of wildlife habitat lost through construction of Dworshak Dam. These studies defined the necessary winter range replacement for the elk of the North Fork-Clearwater drainage area at about 38,000 acres. These mitigation lands consist of 9,500 acres of specially acquired Corps-owned wildlife lands and about 28,000 acres of lands belonging to multiple use Corps projects, the Bureau of Land Management, the State and private interests.

Each of these mitigation projects was begun long after the associated construction projects had already been completed. Such delays, therefore, prompted the North Pacific Division to undertake localized mitigation projects on lands adjacent to the sites of the construction activities. Operating on the principle that all lands—regardless of land-use classification—provide wildlife habitat for some species, these efforts ranged from simple plantings of the right kinds of trees and shrubs in recreation areas to complex revisions of forest management practices.

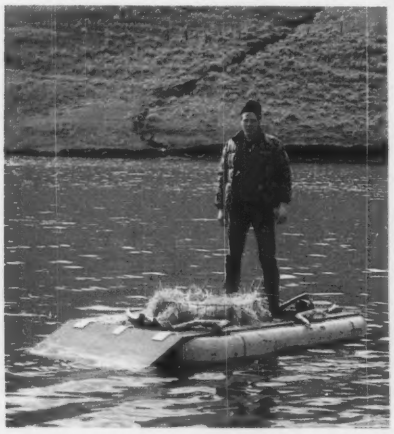
In 1972, an abandoned spawning channel for chinook salmon and 640 acres of land below McNary Lock and Dam, an area used for waste disposal during construction, was converted into a wildlife park. McNary Wildlife Park was developed at a minimal cost by using the same personnel and equipment that built the lock and dam structure. The development included construction of dikes to convert the spawning channel into 100 acres of warm water fish habitat, headed by a ¾-mile trout stream, and surrounded by game habitat ranging from wetlands and marshes to sagebrush.

McNary Wildlife Park has become a favored fishing area, a wildlife viewing arena and a public hunting preserve—but only for those armed with cameras and binoculars. Black-tailed jackrabbits and cottontails find the rubble heaps and brush patches a natural home and safe refuge from the coyote and bobcat. A growing community of beavers, muskrats, secretive river otters, wintering and nesting waterfowl, flocks of ringnecked pheasants and valley quail, and a black-crowned night heron rookery are serenaded by many species of songbirds that cohabit the parklands.

The same year the Walla Walla District began a habitat management program on nonmitigation project lands. During that summer, nearly 400 acres of overgrown brush were crushed and rolled with contracted equipment to encourage regrowth of the tender twigs that sustain wintering deer and elk. Burning of the crushed brush stimulated the germination of redstem ceanothus seeds in the soil, resulting in regrowth of up to 1.5 million stems per acre of this favored browse plant. This was followed in 1973 by rolling and crushing 350 more acres at another site. In 1974 over 180,000 plant-

[1] These are Ice Harbor, Lower Monumental, Little Goose and Lower Granite.

Artificial goose nest constructed of hay bales has been most successful type on lower Snake River. Corps biologist (below) demonstrates buoyancy of floating goose nest built inside surplus World War II life raft fitted with ramp for goslings.



Left—Newly hatched goslings nest on new island at mouth of Snake River. Parents selected nesting site 8 months after island was formed from dredged material.

Center—American avocet frequents shores of marshes, mudflats, lakes and ponds from eastern Oregon and Washington to west Texas. This wide migratory range makes mitigation relatively easy to accomplish.

Bottom—These Forster's terns and several other species of gulls were forced to search for new breeding islands which the Corps created from dredged material.

Rocky Mountain elk of North Fork drainage lost part of winter range to Dworshak Reservoir.

ings of favored species were made to cover the new shoreline and the dam construction scars.

Continued efforts in 1975 include more rolling and crushing. In addition, the selection of Dworshak as a Title X project under the Emergency Jobs and Unemployment Assistance Act has enabled the Corps to hire hardcore unemployed personnel to hand slash and clear additional winter feeding areas for deer and elk.

Recent years have also seen the birth of a new Northwest interagency advisory task force called the Wildlife Working Group. This group is chaired by a representative of the U.S. Fish and Wildlife Service and includes representatives of the Oregon Department of Fish and Wildlife, the Washington Game Department, the Idaho Fish and Game Department and the Corps of Engineers. It is charged with encouraging and monitoring research into the effects of water resource development on wildlife communities.

The group's first official act was to initiate an inventory of riparian habitats and associated wildlife on both the Columbia River, from its mouth to the Canadian border, and the Snake River, from its mouth to the head of Brownlee Reservoir in Idaho. This inventory is being conducted by the Cooperative Wildlife Research Units of Oregon State University and the University of Idaho, and the College of Forest Resources of the University of Washington. It was completed in 1975. A similar inventory, of the lower Clearwater River and Dworshak Reservoir, will be completed in 1978.

Another study updated the Lower Snake River Project's master plan, producing a report on wildlife habitat development that reclassified over 50 percent of the project's lands into *intensive* or *moderate* management categories. A total of 22 intensive management sites will be developed as a result of this study, each site providing fencing, irrigation, cover plots of trees and shrubs, and food plots destined to restore the lost riparian habitats.

This new master plan also details methods by which more habitat than was lost can be replaced within the project lands, sizeably reducing the requirements for mitigation lands. This will relieve many State wildlife

Above—Today elk and deer winter on bark and twigs of redstem ceanothus and other shrubs on slopes adjacent to reservoir.

Left—Rolling, crushing and burning of overgrown brush stimulated resprouting as dense as 1.5 million seedlings per acre of redstem ceanothus, primary winter forage for elk and deer.

Above left—Rejuvenated redstem ceanothus shows signs of heavy winter browsing.

Tree tops and floating trees provided food and cover for whitetail deer that wintered on Dworshak's frozen surface the first year filling began.

Idaho Fish & Game Dept.

agencies of development cost burdens should their State governments decide to leave these lands under Corps management. However, if a State prefers to manage these lands itself, it must then license these lands from the Corps and maintain them at its own expense. Either way, the mitigation is accomplished.

The Corps is also coordinating with States in the Pacific Northwest in even wider ranging endeavors. Assisted by the University of Washington's Institute for Environmental Studies, the Seattle District has prepared a Washington Environmental Atlas that includes sections prepared by local and nationally known experts in virtually all fields pertaining to the environment as they affect Washington State.

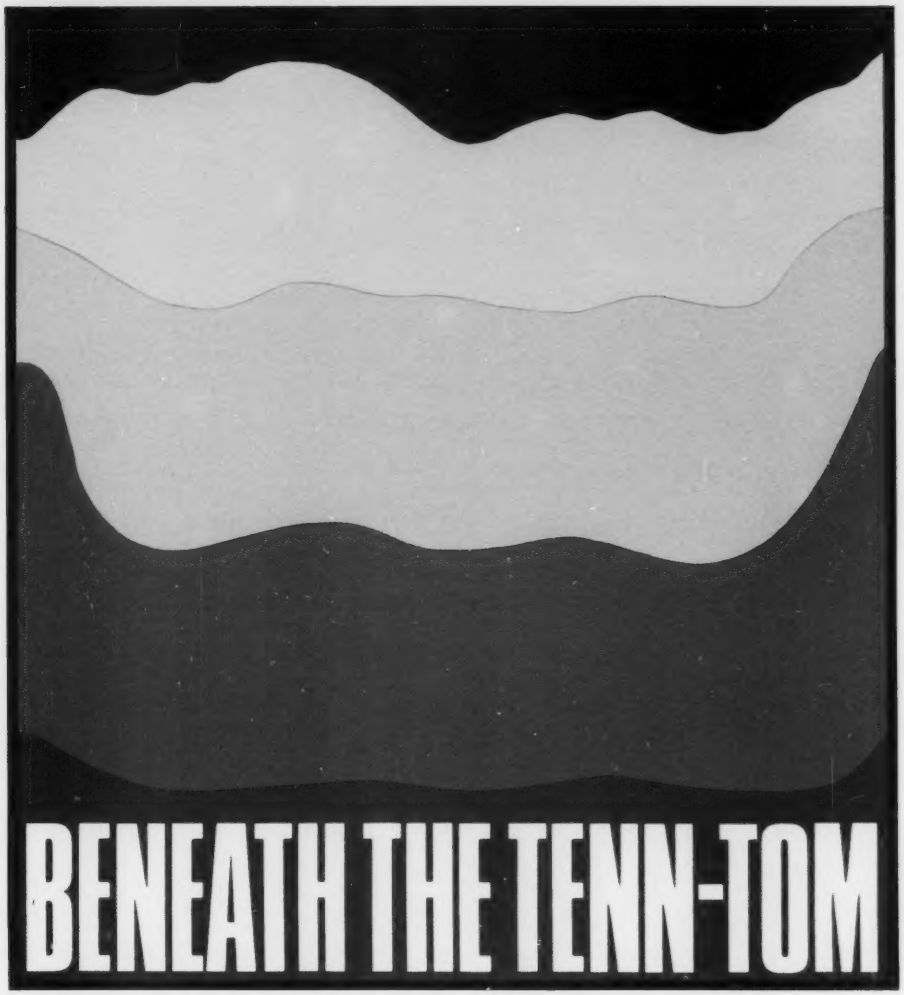
In addition to information gathering and planning activities, the North Pacific Division has adopted new operating procedures and policies designed to protect and improve wildlife habitat. Water impounded by the four dams in the Lower Snake River Project inundated 52 islands that were over 5 acres in size, resulting in the loss of 600 Canada geese a year. Since dredged material created by maintaining channel dimensions on the lower Snake and Columbia Rivers is a threat to wildlife habitat when it is improperly disposed of, this material is now being used to replace the lost islands.

In areas where irrigation withdrawals require shore-based pumping plants—with the associated roads and transmission lines—policies have been adopted whereby manmade intrusions will not be permitted in wildlife management or recreation areas. The only exceptions are where no alternative exists and a true public need has been demonstrated. While strict, this policy has gained recognition from developers of irrigation systems of the Corps' sincerity in protecting wildlife within its own lands. Rather than alienating developers, the new policy has drawn them closer, thereby minimizing development impacts.

The North Pacific Division has adopted policies where all snagging and clearing operations and flood damage repairs in tributary streams must be conducted under supervision of a Corps biologist. First, the biologist must assess potential fish and wildlife habitat dangers well in advance and obtain the concurrences of State and Federal fish and wildlife agents before any work begins. Then the biologist must actually assist in supervising the project and recommend any necessary protective and constructive measures as the work progresses.

Adoption of so many new policies and operating procedures shows how strongly the country's movement into an era of concern for the environment has captured the Corps. As a major water resource development agency, we have had to become familiar with the process of how best to mitigate the corollary loss of wildlife habitat resulting from our construction projects. As a major administrator of public land and a resource management agency—especially of some of the Nation's most important wildlife lands—the Corps has had to accept responsibilities which have carried it well beyond mere mitigation procedures.

Realization of its new responsibilities has come to mean managing all resources present on Corps-owned lands, the most important of which is the wildlife. An expanded role in managing the wildlife resource is the product of that realization.■



BENEATH THE TENN-TOM

by John Van Brahana
Hydrologist
U.S. Geological Survey
Nashville, Tennessee

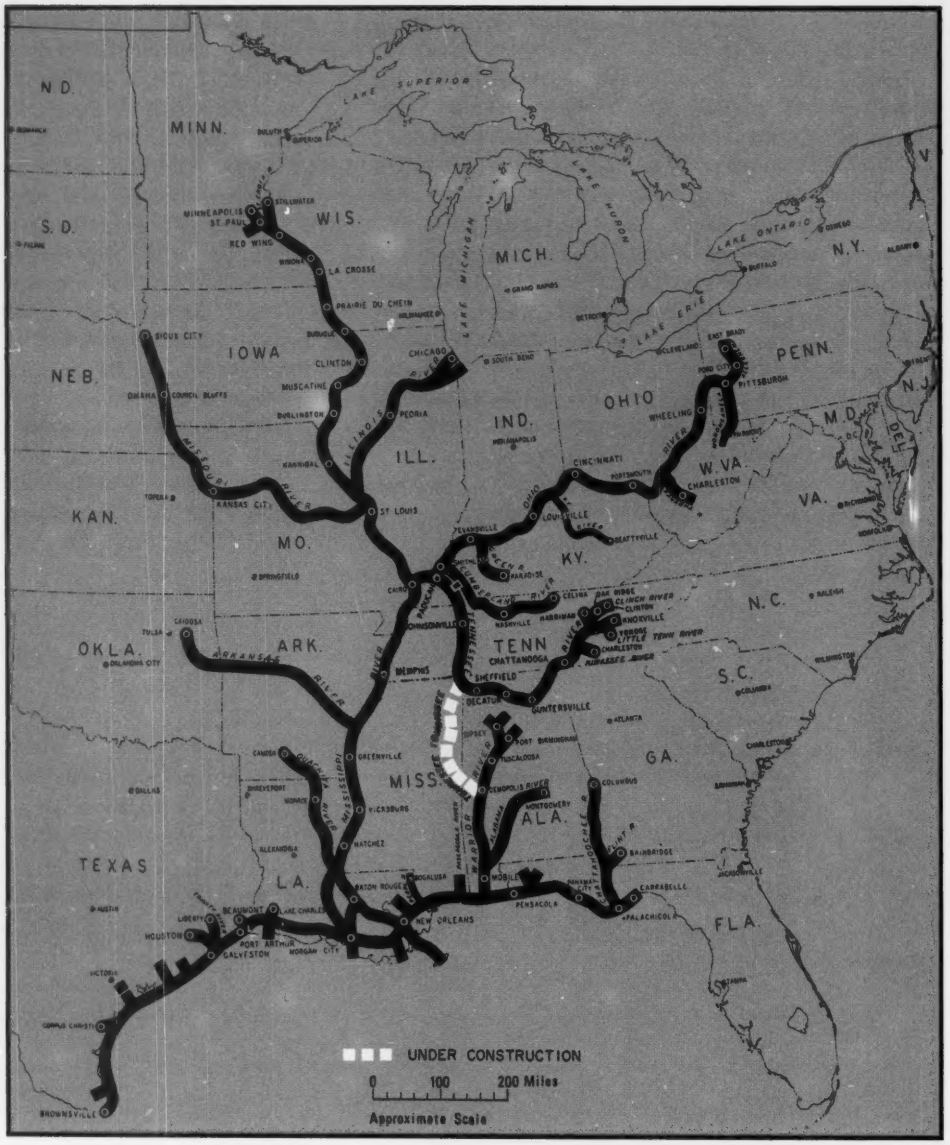
A new waterway soon will connect the inland Tennessee River system with the Gulf of Mexico via the Black Warrior Waterway, shortening some shipping distances as much as 800 miles and extensively modifying the surface-water flow characteristics over a 2,000-square-mile area.

The immensity of the Tennessee-Tombigbee Waterway project, referred to locally as the Tenn-Tom Waterway, involves a strong interdependence between surface and ground water, creating the need to evaluate the hydrologic changes on the adjacent northern Mississippi and west-central Alabama countryside.

Because many Mississippi and Alabama residents rely heavily on ground water as their primary source of water supply, the U.S. Army Corps of Engineers requested the U.S. Geological Survey to predict how that ground water and its chemical quality would be influenced by construction of the new waterway by the Mobile and Nashville Districts of the Corps. The resultant study addressed the anticipated problems in three basic steps:

- define the existing ground-water flow system
- superimpose the construction plans on the existing system, creating a new set of hydrologic conditions
- predict the ground-water response to the new conditions by modeling flow systems

A final step, following completion of the project, will include monitoring the ground-water flow system to compare predictions with measured changes. This will provide a means of separating waterway-induced changes from other effects and improve modeling calibration.



Shortcut to the Gulf.

Existing Hydrologic Conditions

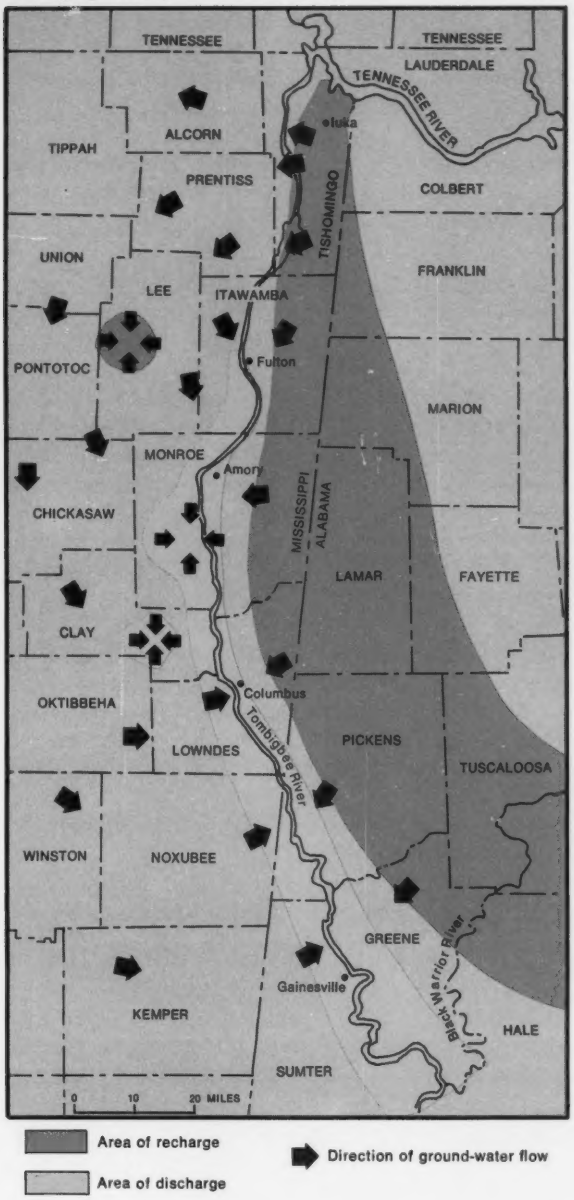
Test holes were drilled at strategic locations along the proposed route to aid in defining the existing flow system. Samples from the layers penetrated in the test drilling are being identified according to the types of underlying rocks, their composition, the sequence in which they occur, and their thickness. Synthesis of these data is providing a regional view of the areal distribution and vertical extent of the geologic formations that will be in hydraulic contact with the future Tenn-Tom Waterway.

Additional information obtained from electrical logs[1] of the drill holes is providing data useful for correlating the different lithologic zones, estimating their thickness and relative porosity, and indicating water quality.

It first had to be determined which formations serve as *aquifers,* to store and transmit water, and which are *confining beds* that retard movement of water. Then observation wells were installed in the drill holes in such a way that each continues to monitor a specific aquifer. This was done by casing off the drill hole from overlying and underlying formations and installing a well screen in that particular aquifer. The observation wells provide access to the aquifer for collecting water-level data and withdrawing water samples for chemical analysis.

[1] Involves lowering a sensing probe into a bore hole to record electrical resistance and other physical properties.

Ground water moves from areas of recharge toward areas of both natural discharge and pumping centers (shown by converging arrows).



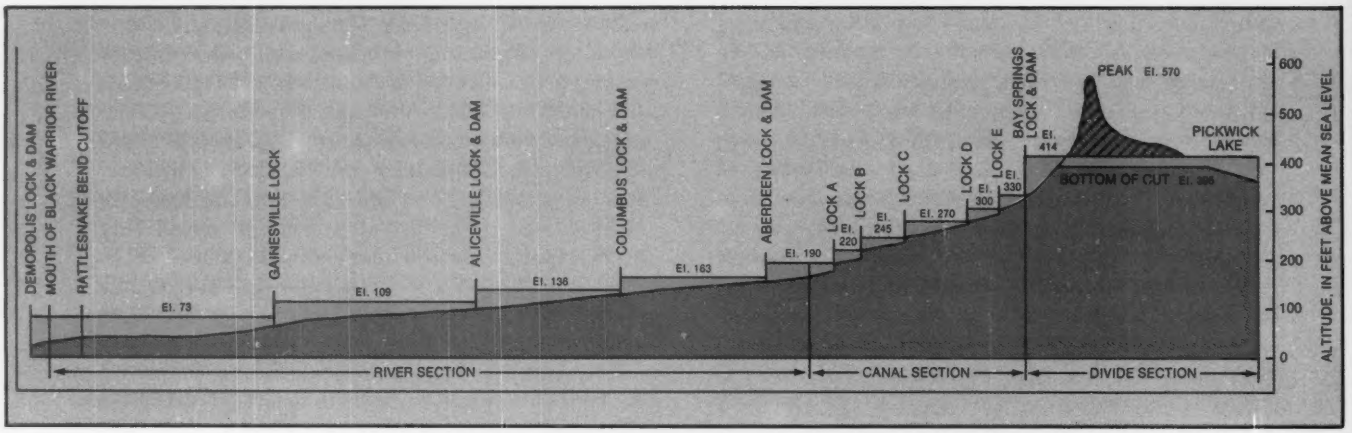
Artesian observation well, common in Tombigbee River valley, indicates confined aquifer under pressure sufficient to create fountainhead over 10 feet above land surface.

The observation wells also were used in a series of pumping tests to determine the transmission and storage coefficients of each aquifer and indicate the effect that pumping of each aquifer has upon the other aquifers. These tests indicated the permeability of the confining beds, which influences construction design and the scope of the environmental effect. The more independently the aquifers react to a stress, the less one aquifer will influence another when a stress is generated.

For this investigation, those aquifers that will be proximate to or otherwise in hydraulic contact with the waterway were those most intensively studied. Initially, this included the unconfined alluvial and terrace aquifers and the shallowest *artesian* aquifer present at each location. An artesian aquifer is a hydraulically-confined formation in which water levels in wells tapping that aquifer will rise above the top of the aquifer. Wherever the pressure at the well is sufficient to raise the water above the land surface, such as in the low-lying Tombigbee River valley, the well tapping the artesian aquifer will flow without pumping.

Water-level data not only define the natural variation of water levels resulting from seasonal changes in recharge to and discharge from an aquifer, they also provide a means for determining ground-water flow direction within the aquifers and, therefrom, the location of boundaries that control the flow system. Defining the boundary conditions became a complex task

Waterway profile depicts proposed pool elevations from Pickwick Lake on the Tennessee to Demopolis Lock and Dam on the Black Warrior.



because of differences in formation characteristics, the irregular areal distribution of the aquifers, and the complex relationship of ground water to surface water. Comparisons of water levels, water quality, and the contribution of ground-water discharge to the base flow of streams were used to define the existing boundaries.

New Boundary Conditions

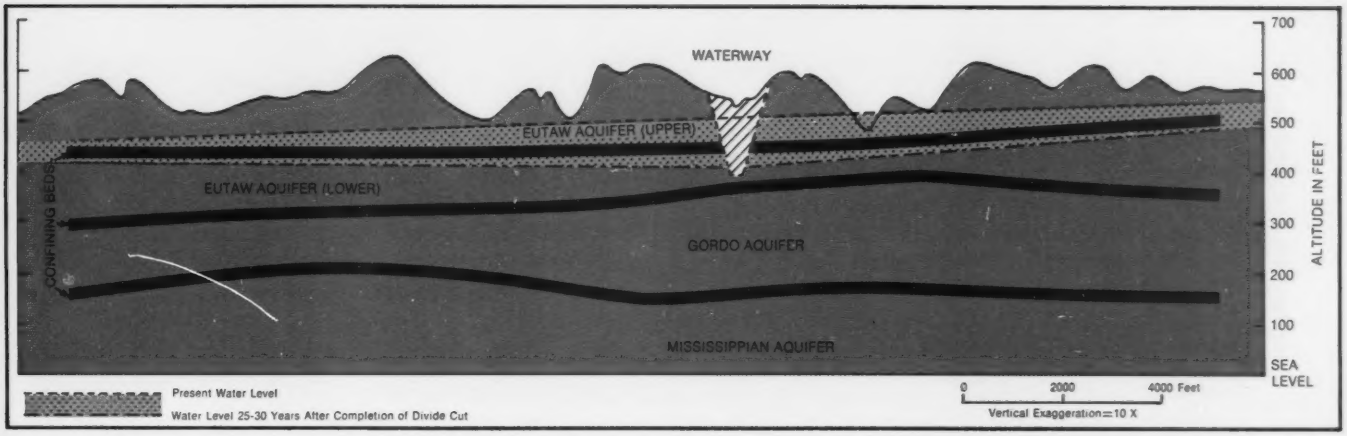
Construction plans for the waterway will define new surface-water boundary conditions along the proposed route which, in turn, will establish new boundaries for the associated ground-water system. Obviously, the new boundaries will require adjustment to a new equilibrium by the ground-water system.

The 253-mile waterway is divided into three sections, each different in the method by which it will be constructed. The 40-mile northernmost part, known as the *divide* section, will require a cut of 27 miles through the divide separating the Tombigbee and Tennessee River basins. This cut, which will be as deep as 175 feet at the crest of the divide, will require the excavation of 145 million cubic yards of sand, clay, gravel and rock—more than two-thirds as much material as that excavated for the Panama Canal.

Banks in the divide cut will be at a 1 to 3 slope, water depth will be at least 9 feet, and the bottom width of the channel will be no less than 280 feet. Bay Springs Lock and Dam in Mississippi will mark the southern

Plymouth Bluff, a scenic overlook on the Tombigbee, was spared from inundation by relocating Columbus Lock and Dam.

Diagrammatic cross section shows that ground-water levels may be lowered more than 100 feet adjacent to the divide cut near the middle third of the divide section.



limit of the divide cut. This lock will have a lift of 84 feet, the second highest in the eastern United States.

The middle, or *canal* section, will be a 45-mile-long channel approximately parallel to Mackeys Creek and the Tombigbee River. It will be constructed on the alluvial flood plain and include five locks having lifts ranging from 25 to 30 feet. A single-wall levee and the natural valley wall will be used to maintain the elevated water levels in the canal at a minimum channel depth of 12 feet and minimum bottom width of 300 feet.

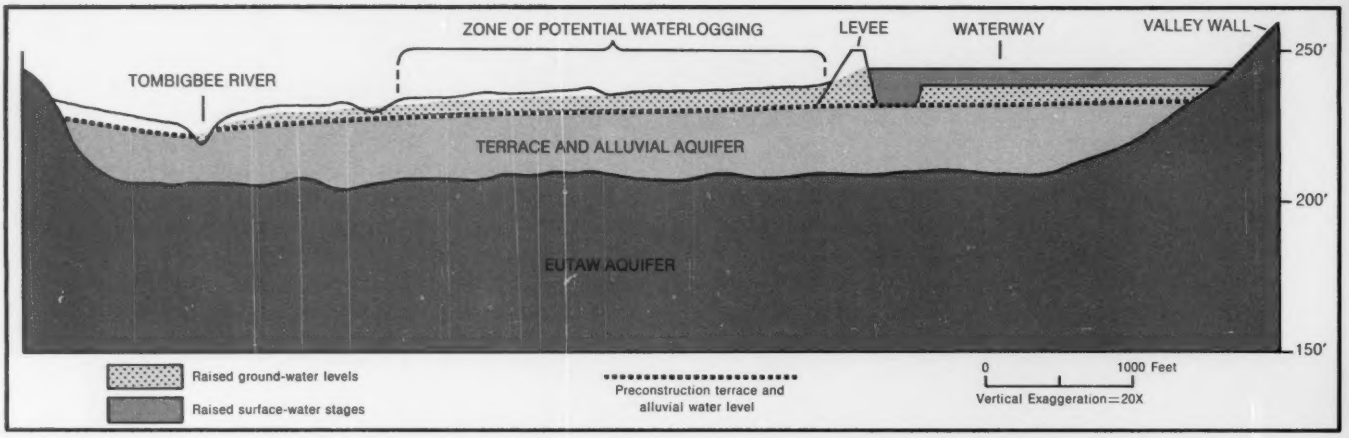
The *river* section will begin immediately south of Amory, Miss., consisting of 168 miles of improved channel and meander cutoffs, and will include four locks and dams. For the most part, the river section will occupy the present Tombigbee River channel with a minimum depth of 9 feet and minimum bottom width of 300 feet.

Aquifer Response

Aquifer responses to new boundary conditions will consist of reestablishing hydraulic-energy states that will vary according to the degree of interconnection between each of the aquifers and the surface water in the waterway.

For example, in Tishomingo County, Miss.—on the west side of the divide cut—existing ground-water levels in the Eutaw and Gordo aquifers are presently stabilized approximately 500 feet above sea level with a layer

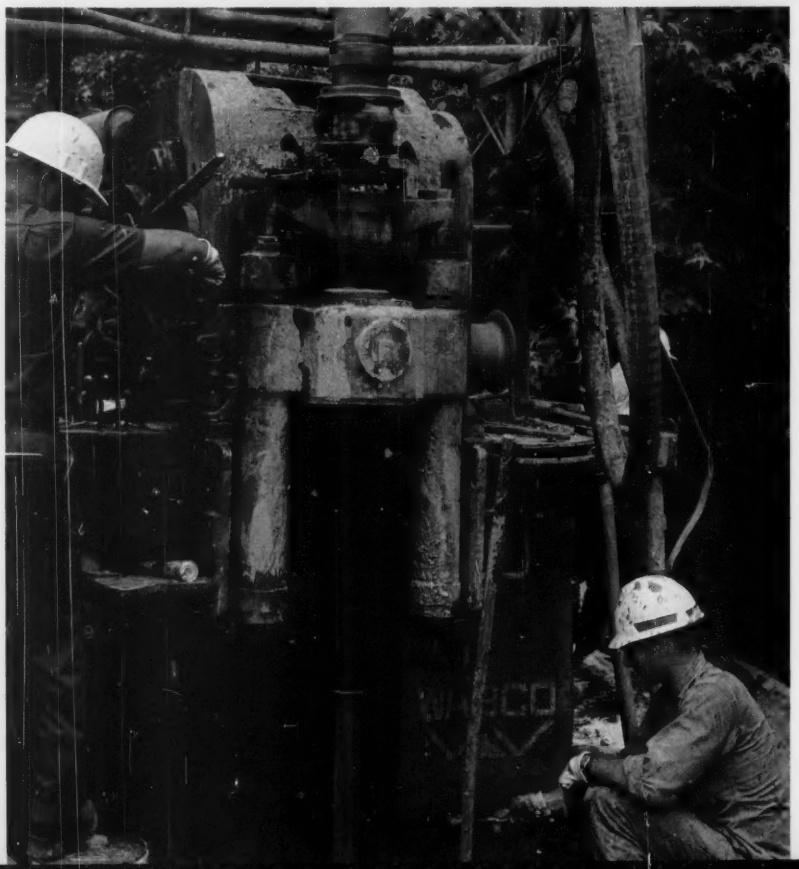
Newly constructed Yellow Creek Port Terminal, located on Pickwick Lake at north end of Tenn-Tom, provides rail, dock and warehouse facilities for shippers utilizing inland water system.



of clay between them. The path of the waterway through Tishomingo County will be approximately perpendicular to the existing direction of ground-water flow and the divide cut will penetrate deeply into the underlying aquifers. However, the planned water level within the waterway will be only slightly over the 400-foot altitude, which will represent the controlling boundary. Thus, water levels in the upper Eutaw aquifer will decline as much as 100 feet immediately adjacent to the cut, near the midpoint of the divide section. The regional change in the water table will depend on the effectiveness of the clay formation between the Eutaw and Gordo as a confining bed.

This deep penetration at the divide cut also suggests that the waterway will intercept the flow of essentially all ground water east of the cut that now moves toward the west and southwest in the Eutaw. In the future, this intercepted ground water will discharge into the water-

Drilling provides wealth of information about water in underground rock layers. This drill hole is currently used as observation well to monitor water level and quality changes in Eutaw aquifer.



Pockets of fragile beauty dot future waterway route, underlining need to protect adjacent land and its resources.

way and move downstream as surface water. There is a possibility, though, that some of the shallower sandy zones in the Eutaw may sustain a "perched" water table considerably above the water level in the main body of the aquifer. This occurs due to restriction of downward movement by the above-noted clay layer.

The initial part of our study also revealed the existence of high artesian pressures in the lower part of the Gordo aquifer. There may be as much as 100 feet of artesian head in the Gordo if the clay layer separating the Gordo from the Eutaw actually is an effective confining bed. This amount of head could cause "blowouts" or "sand boils" in the bottom of the canal if that pressure is not relieved during construction and subsequent operation of the waterway.

A system of dewatering and pressure-relief wells may be necessary in the artesian aquifers in the vicinity of the waterway. One approach to handling this problem is a current study to determine the effect of imposing hydrogeologic controls on the economics of selected designs for various dewatering and relief systems.

Ground-water changes in the waterway's canal and river sections are expected to be the opposite of those in the divide section. Surface-water levels in the canal and river sections will be raised above preconstruction stages by levees. Depending on the degree of interconnection with alluvial and terrace aquifers, extensive infiltration—with attendant waterlogging in lowland areas—could lead to both positive and negative results. Expansion of wetlands into areas now subject only to periodic flooding would provide additional refuge for certain types of wildlife and increase the recreation potential. Also, the increased infiltration into the alluvial and other shallow local aquifers could recharge well fields capable of supporting irrigation or light manufacturing needs. On the negative side, the raised water levels may claim some land now being farmed.

Either raising or lowering the water level would change both the pressure of the water in the pores and the stress on the rock particles in the underlying artesian aquifers. However, the sediments comprising these aquifers have been preconsolidated by much greater loading changes through the geologic past. Therefore, consequent effects of pressure and stress changes, if any, should be very small.

Other observable changes associated with reequilibrating water levels will take place, such as variations in the base flow of streams and changes in yields from wells.

Following are some of the changes in the water quality of surface water that may occur during construction and others that may result from subsequent operation activity:

- increase in sediment loads
- increase in turbidity
- pH change in vicinity of fresh cuts
- thermal stratification in deep impoundments
- introduction and concentration of minor metals
- decrease in dissolved oxygen
- increase in wastes from developing areas
- changes in nutrient loading
- contamination from accidental spills of material being transported

Some of these effects on the quality of the surface water may be transmitted to interconnected aquifers and thereby change ground-water quality.

Study Results

Water levels will be raised along 90 percent of the waterway, enhancing opportunities for ground-water development in adjoining areas. In the remaining 10 percent, which is the cut in the divide section, water levels will be lowered about 100 feet adjacent to the cut near its midpoint but closely approach the original levels at the north and south ends of this reach.

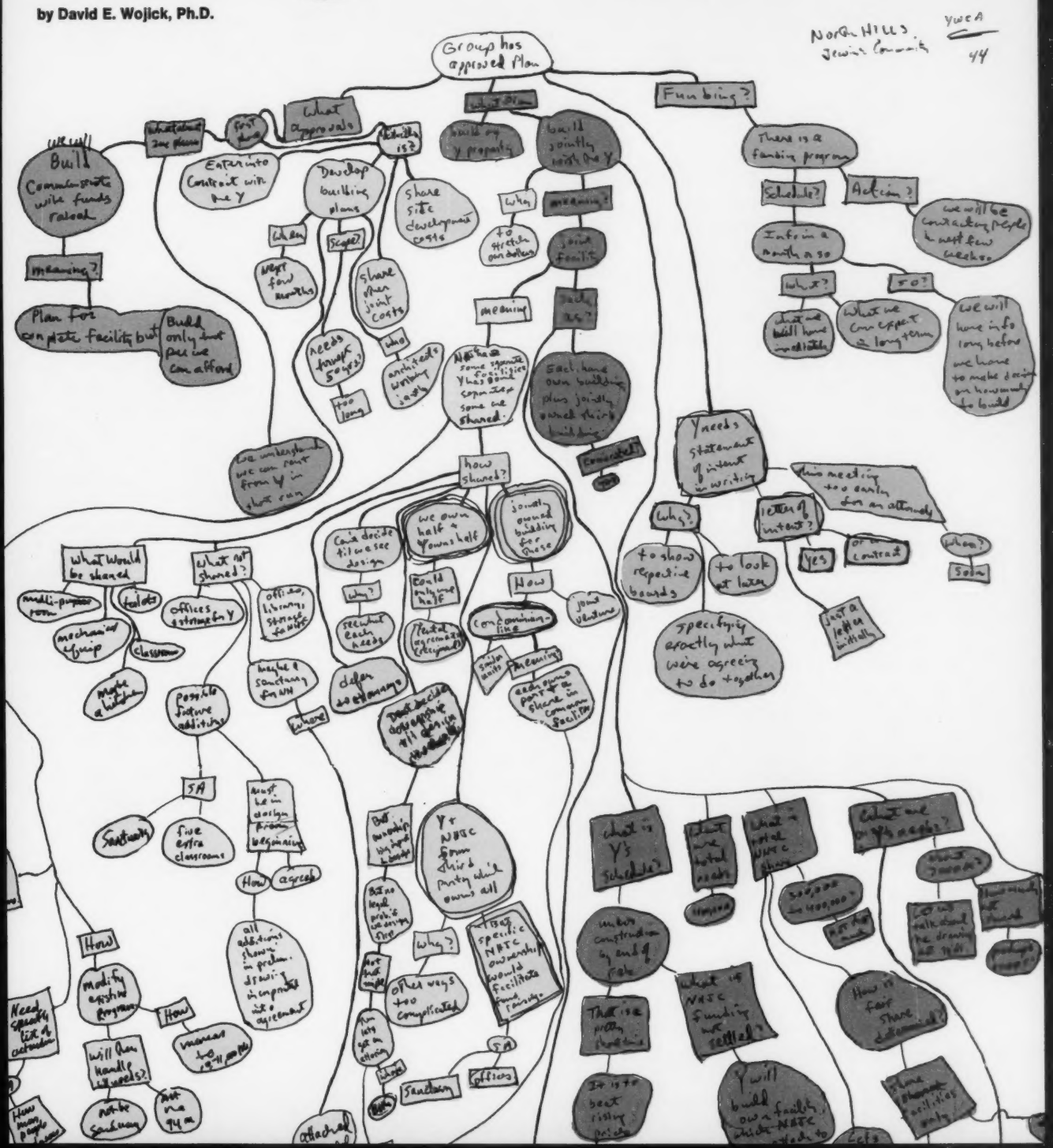
The ground-water studies revealed water problems which had not been anticipated in the construction planning. This provided the necessary lead time to incorporate changes in the construction techniques that will resolve these problems. One study, utilizing a digital model to simulate the ground-water system, suggested several alternate ways to dewater the cut in the divide section. Each method is currently being tested under actual field conditions to determine the most effective method with the least impact on the ground-water environment.

The end result of this study will not come until the new conditions of equilibrium are reached. Current monitoring is confirming the model predictions for the initial construction changes, but validation of our simulation modeling will not be complete until all segments of the waterway's construction are fully underway. We expect aquifer monitoring to contribute significantly to our knowledge of the hydrology of the Tenn-Tom region.

The growing importance nationwide of ground water as a giant underground water reservoir—free of sediment, free of pathogens, and with a nearly constant temperature—demands that we turn our collective attention to understanding its behavior more thoroughly, and, specifically, to predicting—with confidence—what will happen when we modify a given ground-water regime.■

Treeing the Issues

by David E. Wojick, Ph.D.



The simple approach toward unravelling public problems by *treeing* them rewards the issue analyst with some startling results. All issues—large or small—have a basic underlying structure no matter how complex they appear. Grasping the nature of this *tree* structure can improve our understanding and communication.

Preceding page—A proficient issue analyst can tree a discussion as it occurs. Different colors indicate closely related ideas or points.

How big is an issue? What makes an issue complex? Is one issue more complex than another? At first such questions may sound strange, but exploration of a large number of complicated public issues suggests that there are answers—and simple ones at that.

Several years of experimentation with various State and Federal agencies led our group at Carnegie-Mellon University to the conclusion that every issue has an underlying structure, one that can be literally "mapped out" on paper like an engineering drawing. Moreover, these drawings can be used to improve communication, understanding and the resolution of competing interests.

An issue is, by definition, a problem with several points of view. A public issue is one which involves action by a public agency, such as the U.S. Army Corps of Engineers or the Environmental Protection Agency, and—in addition—may be national, regional or local in scope. For example, the general issue of disposing of dredged materials is of national concern and attention, while dredging a particular river may be a regional issue and the choice of a particular disposal site is often a big, but usually local issue.

Several years ago we became concerned that the public was not aware of the complexity of the many environmental and energy related issues that were then being raised. To try a new approach toward solving the problem of complex public issues, we "atomized" an issue by taking every single statement we could find on that topic and then attempting to fit all of these statements together into a coherent whole.

The results were startling: we found to our surprise that these statements, several thousand in all, fit together into a simple scheme. The issue in question, while very complex, turned out to have a relatively clear underlying structure that presented a logical pattern.

Moreover, once we grasped this structure, it was easy to see how one main issue (in this case, auto energy use) divided itself, on the basis of certain key questions, into several major subissues. Each subissue divided into sub-subissues, which in turn subdivided, etc. Because the resulting hierarchical structure is called a "tree" by mathematicians, we called our discovery an *issue tree*.

Since that first discovery, a large number of issue trees have been constructed, all revealing variations of the same basic underlying form—the tree. We also have experimented extensively with using issue trees to improve communication and understanding where complex questions were involved.

This work was carried out initially under a grant from the Carnegie Corporation of Pittsburgh. We then tested practical applications with a number of urban planning firms, as well as several public agencies; these included the Governor's Energy Council for the State of Pennsylvania and the Waterways Experiment Station for the Corps of Engineers, located at Vicksburg, Miss.

Through this field work we were able to establish certain benchmarks related to the size of an issue. The number of points required to resolve an issue will vary with the number of factors that must be considered as well as the level of detail that must be reached. In general, the addition of a new factor will result in a simple percentage increase in the size of the tree, while adding another level of detail will increase the point count exponentially.

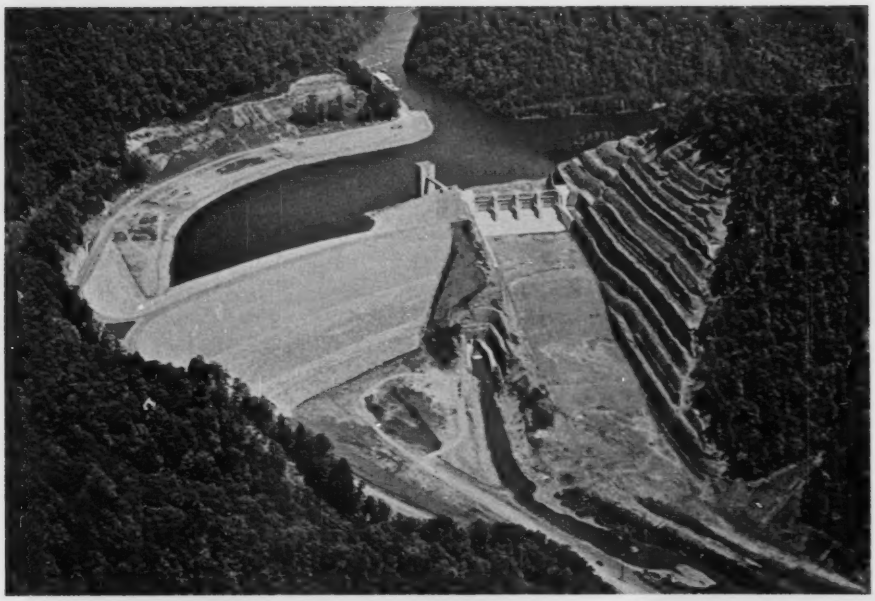
A typical local issue, for example, if discussed to the level of detail necessary to begin resolving conflicting interests, will yield an issue tree of from 1,000 to 10,000 statements, or *points*.

For a major national issue—such as how to achieve energy conservation—hundreds of thousands, if not millions, of points must be put together before the issue will be resolved.

Building and using issue trees has shed considerable light on the problems of achieving efficient communication, mutual understanding and resolution of conflicting points of view. For example, while 2,000 points might typically produce a good understanding of an issue, people usually generate only about 100 to 150 points an hour. This means it takes a lot of careful attention to really work through an issue, attention which people are often unwilling or unable to sustain. We believe that this single fact—the very size of most issues—accounts for a great deal of the difficulty which often attends the resolution of public issues.

Moreover, because the underlying structure of an issue is treelike—that is, because very often several points branch off a single preceding point—it is easy to get lost

Dr. Wojick is a professional engineer and assistant professor of philosophy in the Department of History and Philosophy at Carnegie-Mellon University, Pittsburgh.



An issue tree can be used to visually simplify resolution of oral statements by competing interests.

in the detailed subissues. As a result, at least four things often happen when people try to discuss a complex issue:

- Different persons may want to go in different directions; that is, to follow different "lines of thought" or sequences of points. This leads to tension and frustration.
- The need to continually return to certain points to reorient oneself in the tree leads to seemingly endless repetition, which causes boredom and further frustration.
- The complexity of the tree structure makes it relatively easy to "lose the thread" of the discussion. Even an entire group may lose track of where they are or, alternately, someone may make a point which no one else can follow, because he or she has misjudged the location of the discussion in the tree.
- Because of the multiplicity of pathways which must be worked through to resolve an issue, it is almost certain that important points will be missed the first few times a topic is examined. Such oversights may lead to a sense of incompleteness regarding the current discussion, as well as misunderstanding and mistrust later on.

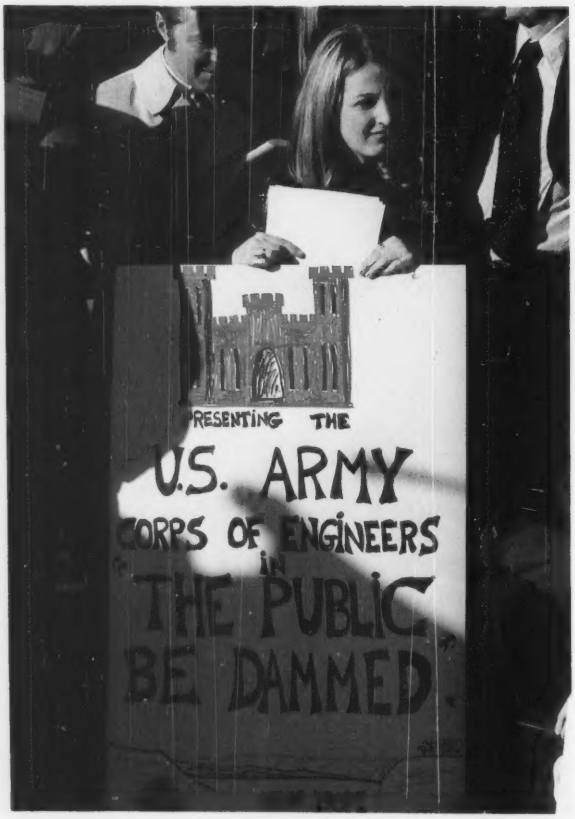
Believing that many of the problems of efficient issue resolution stem directly from the complex structure of most issues, we have experimented extensively with helping people understand the structure of issues in order to resolve them. There are basically three ways of helping which we call, respectively, the *display*, the *analytical* and the *interactive* uses of issue trees. These operate as follows:

- In the display case, a preliminary issue tree is prepared and used as a format or framework for the discussion of some question. This helps prevent confusion and becoming lost in the tree.

- In the analytical case, preexisting discussions of an issue are "treed out" to determine just what the issues are. The resulting tree may be analyzed for such things as confusions, misunderstandings, unresolved issues and potential conflicts.
- Interactive use of issue trees is really a combination of the analytical and display uses in that the tree of one discussion is used as the format for a succeeding discussion, either by the same group or by new people. In this way a systematic discussion may be sustained over a long time. Moreover, a great variety of opinions may be collected and made to interact, even though only a few people participate at a time. This use of issue trees is the most efficient in terms of rapid identification of the extent of an issue and the alternatives for its resolution.

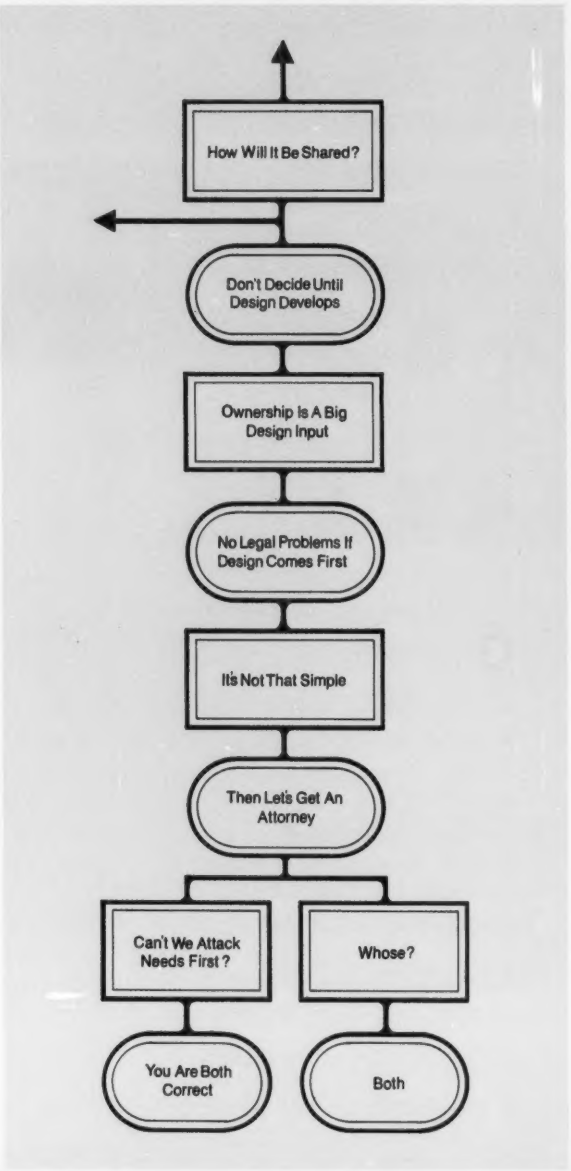
One of the most extensive applications of issue analysis to date was a project undertaken by the Pennsylvania Governor's Science Advisory Committee to investigate points of conflict among energy, environmental and economic policies. Using the interactive issue tree approach, the testimony of more than 100 experts, taken over several months, was boiled down to the most critical 150 points for executive attention. As a result of this project, we have begun to experiment with issue analysis as a technique for project evaluation and technology assessment under a grant from the National Science Foundation.

Reactions such as this encouraged a new approach toward solving complex public issues.



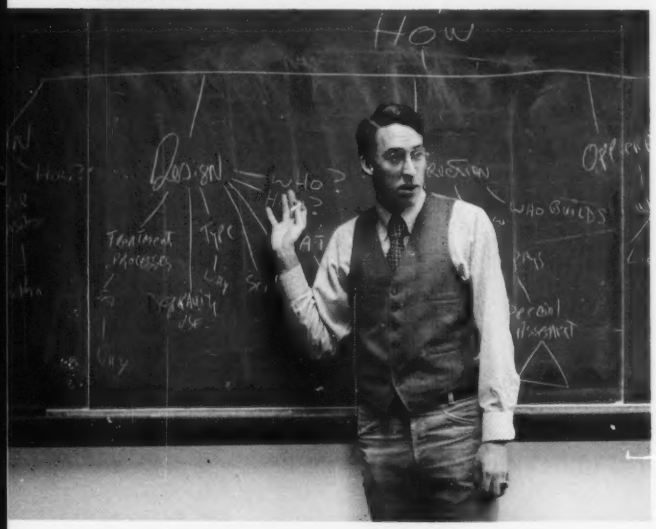
To date a considerable number of people have been trained at Carnegie-Mellon in the building of issue trees. The task seems to be no more difficult than using a hand calculator, with about the same range of sophistication. In just an hour one can learn the basic principles and how to recognize simple patterns. About a week seems to be all the time necessary to become a

This discussion about two civic organizations jointly sharing a new building ended in chaos.

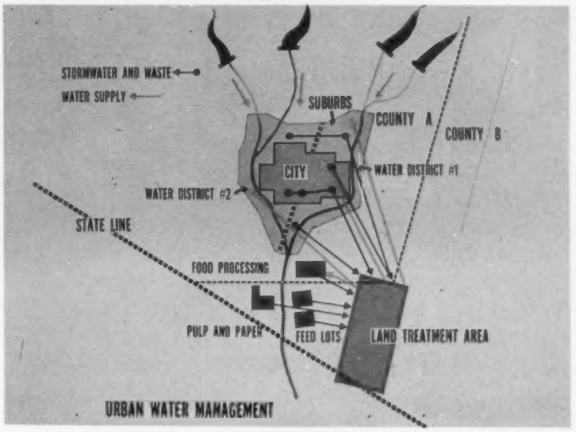

How Will It Be Shared?
Don't Decide Until Design Develops
Ownership Is A Big Design Input
No Legal Problems If Design Comes First
Its Not That Simple
Then Lets Get An Attorney
Can't We Attack Needs First ?
Whose?
You Are Both Correct
Both

Its very size accounts for much of the difficulty in resolving an issue such as this proposed dam now under construction on Bear Creek near Denver, Colo.

Author explains intricacies of blackboard "tree" during a discussion.



A typical local issue should be discussed down to level of detail necessary to resolve conflicting interests.



sophisticated practitioner. The mark of the really proficient issue analyst is being able to draw the tree of a discussion as the discussion proceeds.

The key to building issue trees is the fact that when an issue is discussed, almost every point made is directed or aimed at some other point that has already been made. Therefore, building a tree consists of identifying each point and its target.

There are only five kinds of points: opening statements, questions, answers, objections and replies. Each path through a tree represents a single line of thought, or sequence of points, proceeding from an opening statement. Each line of thought reads like a dialogue between two people who alternately ask questions of and reply to one another, or object to each other's questions or replies, and so on.

The tree structure occurs because often several points may branch off a single earlier point: several answers may be proposed to a single question, several objections may be lodged against a single answer. This "branching" of thought is what makes an issue complex and difficult to grasp in detail.

It seems an inescapable fact that during the reasoning process we are always struggling, point by point and thought by thought, to grasp what is in actuality a complex system of ideas. Our experiments to date have indicated that understanding this complexity through the construction of issue trees will prove useful in improving our ability to grasp important issues.■

The concept of nations holding periodic world congresses devoted to discussing mutual concerns relating to navigation evolved into a permanent international association at the turn of the century. This article explains how the organization of today, formed yesterday, assists its member nations to foresee the needs of tomorrow.

by Carl H. Bronn
Executive Director
National Water
Resources Association

PIANC

Toward the close of the 19th century, a number of national governments agreed that common navigation interests merited an international exchange of ideas. High-level professionals from each nation convened an international congress for this purpose, which proved so productive that the governments involved gave permanent form to a new organization. Its purpose was to exchange technical and professional information among national policy makers.

Formally designated the Permanent International Association of Navigation Congresses, its title was quickly shortened to the acronym PIANC by its own members. For PIANC members, the "navigation" part of its title has had more to do with guiding the courses of nations than ships. That guidance was to come through application of knowledge and influence toward development and safeguarding of rivers, estuaries, canals, ports, approaches and coastal areas. Since the impetus for the formation of PIANC came from the top levels of the member governments, the overall result sought was, and remains, the enhancement of the public welfare—both within and among the member nations.

PIANC accepted the United States as a member in the year 1902 and selected Brussels, Belgium as the permanent site for its international headquarters. America has continued to participate since that time under the authority of Congress and dual sponsorship of the Departments of State and the Army.

In the United States, the Corps of Engineers is responsible for constructing and maintaining this Nation's navigational works. Our own delegation, therefore—referred to as the U.S. *Section*—by tradition names the Director of Civil Works in the Office of the Chief of Engineers as its president and the Resident Member of the Board of Engineers for Rivers and Harbors as the section secretary.

How PIANC Functions

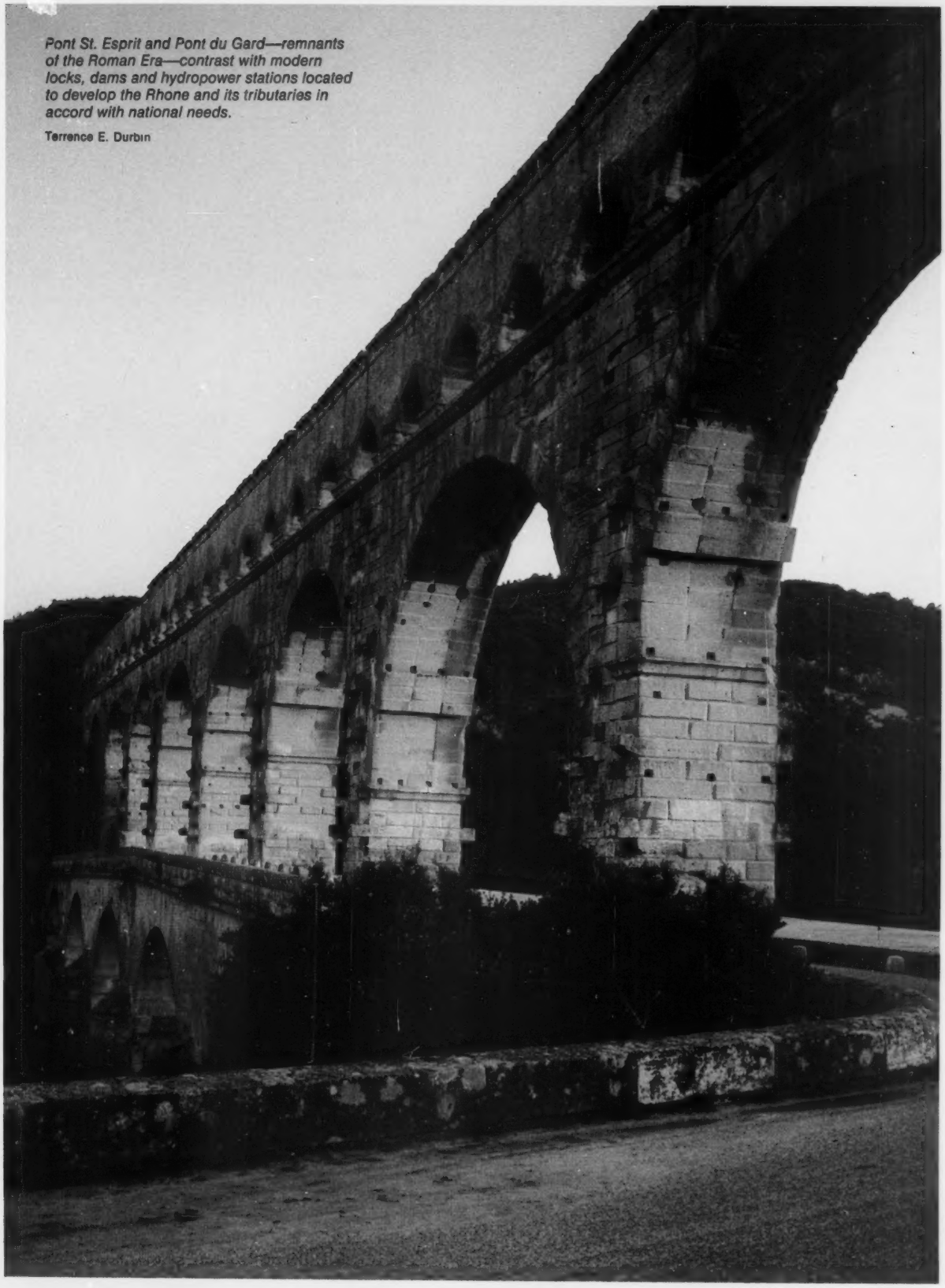
Association members are sought among diverse sources such as representatives from public entities, universities, corporations and the general populace. The aim is to mobilize professional training, experience, broad outlooks and authorities from many disciplines.

For special tasks, ad hoc committees, or *commissions,* are established. The formal outputs of these commissions, discussed later in this article, are augmented by regularly published bulletins, papers distributed for discussion at the association's quadrennial congresses, and other work. Post-congress tours reinforce the written work with on-site examination of outstanding construction and development projects in the host country.

PIANC actions are directed by a Permanent International Commission (PIC) appointed by the member governments. In the United States, PIC appointments are made jointly by the Departments of State and the Army. This commission is comprised of delegates representing more than 40 national governments, generally reflecting a cross section of the national memberships, often headed by that nation's top civil works functionaries. Chairmen of the technical committees also attend the annual PIC meetings, since they are usually linked with excursions of technical value.

The Congresses

The quadrennial congresses are preceded by the publication of professional papers on subjects selected by the PIC. Those subjects, as well as the subsequent discussions, are organized into two groups, according to their orientation toward *ocean* or *inland* developments. The papers are written by carefully selected authorities, reviewed by others, then prepared in either English or French, with condensed versions in the alternate language. Each PIANC member is furnished one set of



Pont St. Esprit and Pont du Gard—remnants of the Roman Era—contrast with modern locks, dams and hydropower stations located to develop the Rhone and its tributaries in accord with national needs.

Terrence E. Durbin

papers on inland or ocean subjects—as that member elects—before the next congress convenes.

The papers are discussed during that congress, with simultaneous translations being provided. For each subject, a group of reporters determines and issues a proposed recommendation or observation for the congress at the final plenary session.

Positions advocated by the reporters are debated in the final plenary session and either adopted, modified or rejected. The results, including the floor discussions, are published in English and French.

Within a decade of PIANC's organization, its congresses had developed sufficient international recognition to encourage sponsorship by the chiefs of state of the host nations. For example, President Taft personally opened the first congress held in the United States, and President Kennedy was patron for our 1961 congress in Baltimore.

Baltimore and Washington, D.C. both will be revisited in June of 1976, when the PIC delegates of the member governments meet in this Nation's capital.

The U.S.S.R. will host the next week long congress in September 1977. It will be centered in Leningrad, with post-congress technical visits being arranged to the Moscow Canal, the Dnieper River and its port of Kiev, the Black Sea ports, hydropower stations and ports on the Volga and Volga-Don, and several hydropower installations in Siberia. The variety of post-congress tours available will illustrate Russia's development and conservation practices concerning its extraordinary water and mineral resources.

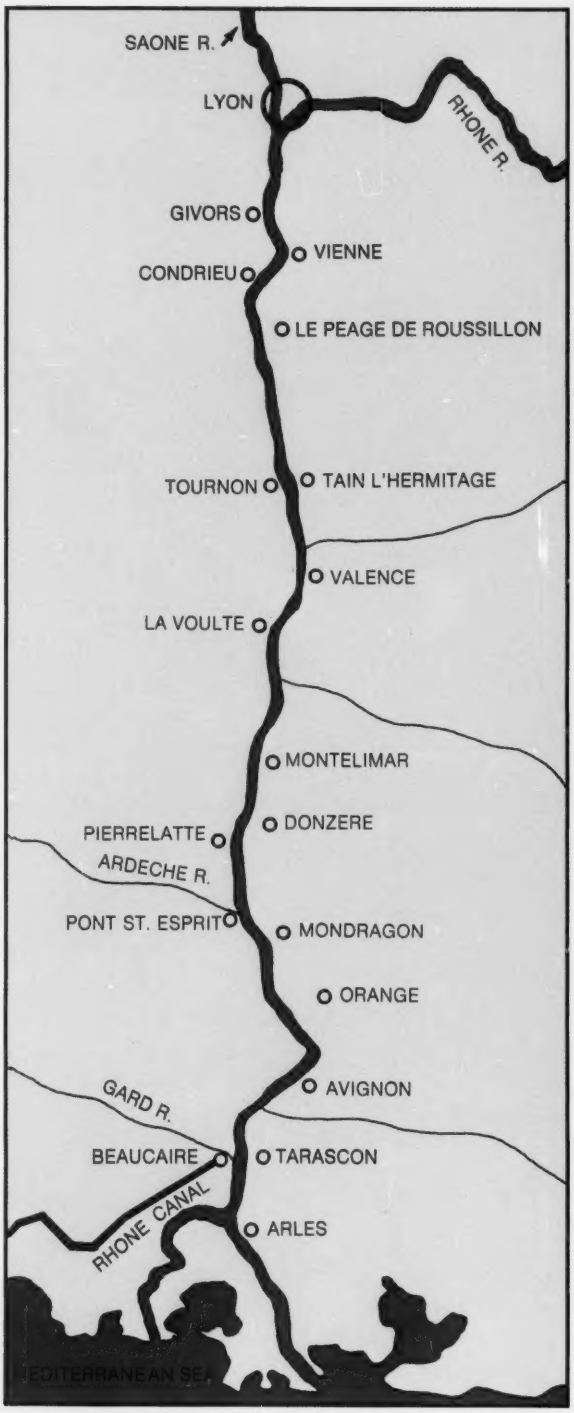
Government and the Entrepreneur

The strong interest of national governments in PIANC has raised this question: Does the organization promote governmental activity over private?

No. PIANC promotes knowledge, understanding, coordination and cooperation among professionals representing national governments, quasi-governmental entities, universities and other types of enterprise engaged in water resource work. The respective national aims of the participants are dovetailed into their handling of social, economic, and ecologic problems related to the water resource.

Worldwide, explosions both of population and of people's expectations are affecting this water resource. This suggests restudy of the respective roles of governments and the private sector. Perceptive, multidisciplined restudy can be aided by international, intergovernmental, public and private examination of common issues. That is an aim of PIANC, just as it was the theme of an international conference on *Water for Peace*, called and attended by President Lyndon Johnson about 9 years ago.

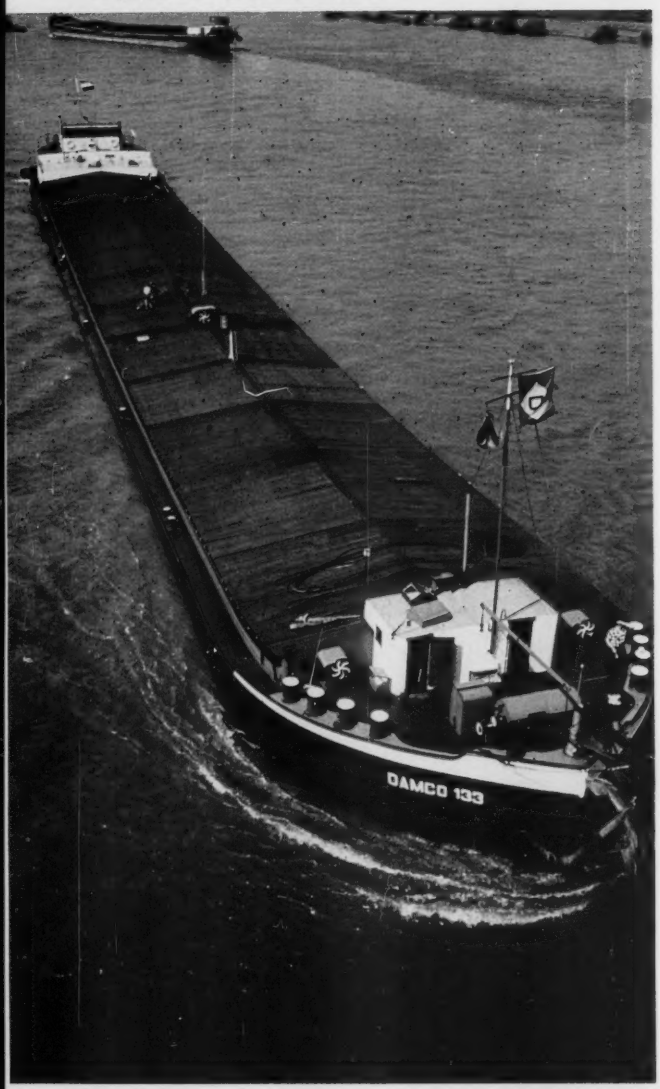
Current concern as to America's aims and roles was



French national policy includes controlled development of the Rhone Valley's water resource to achieve regional demographic, social, environmental and economic goals.

Compagnie Nationale du Rhone

European inland waterways traffic, unlike United States, is 95 percent self-propelled vessels.



strongly evident in April 1975, when the United States government convened a *National Conference on Water*; participants were Federal, State, local and nongovernmental authorities. The Secretary of the Interior opened the proceedings by asking participants to examine both the function of water in national affairs and also the sharing of responsibilities—private, regional and national.

National interests in water resources, and their relationship to private interests, are matters about which PIANC affords a unique perspective. PIANC is composed of governments—capitalist, labor, socialist—yet encourages participation by quasi-governmental agencies, private corporations and 4,000 individuals from 50 or more nations!

Aims[1]

I suggest that PIANC has a remarkable capability because it can tap the following: experiences of water resource executives at high levels of governments, research and analysis by eminent authorities, and science and management expertise from public and private enterprise. Furthermore, this talent potential emanates from nations large and small, developed and aspiring, progressing under differing climates and cultures. Opportunities for both depth and range in communication among member nations certainly are substantial.

Inside PIANC, therefore, one can examine the broader impacts of national water policies and practices such as: the particular goals of specific programs, government aims, and the virtues and limitations of alternate systems for taking action to achieve national aims.

To illustrate: In a discussion with French experts of PIANC, one could examine the interests of their central government, of local entities, and of productive

[1] "Aims" is used in the sense of basic obligations to be fulfilled in the interests of a viable society.

Traffic jam on Rhine indicates waterways are as important as railroads and highways in European economy.

enterprise in the waters of the beautiful valley of the Rhone. A dozen years ago, opportunities there seemed fewer than in the large cities outside of the valley. Consequently, rural to urban migration was underway, despite existing problems of heavy population densities in the receiving areas. Continued migration would be disadvantageous to the people of both the losing and the receiving sectors. Furthermore, all the people of France would enjoy far less than optimum national benefits from the renewable resources (sun, water and soils) of the Rhone region if the high rate of migration continued.

Could the migration of people be slowed? Would practicable plans involve the water resource? If so, would the "marketplace" conceive and execute a plan on a scale that would cope effectively with the problems?

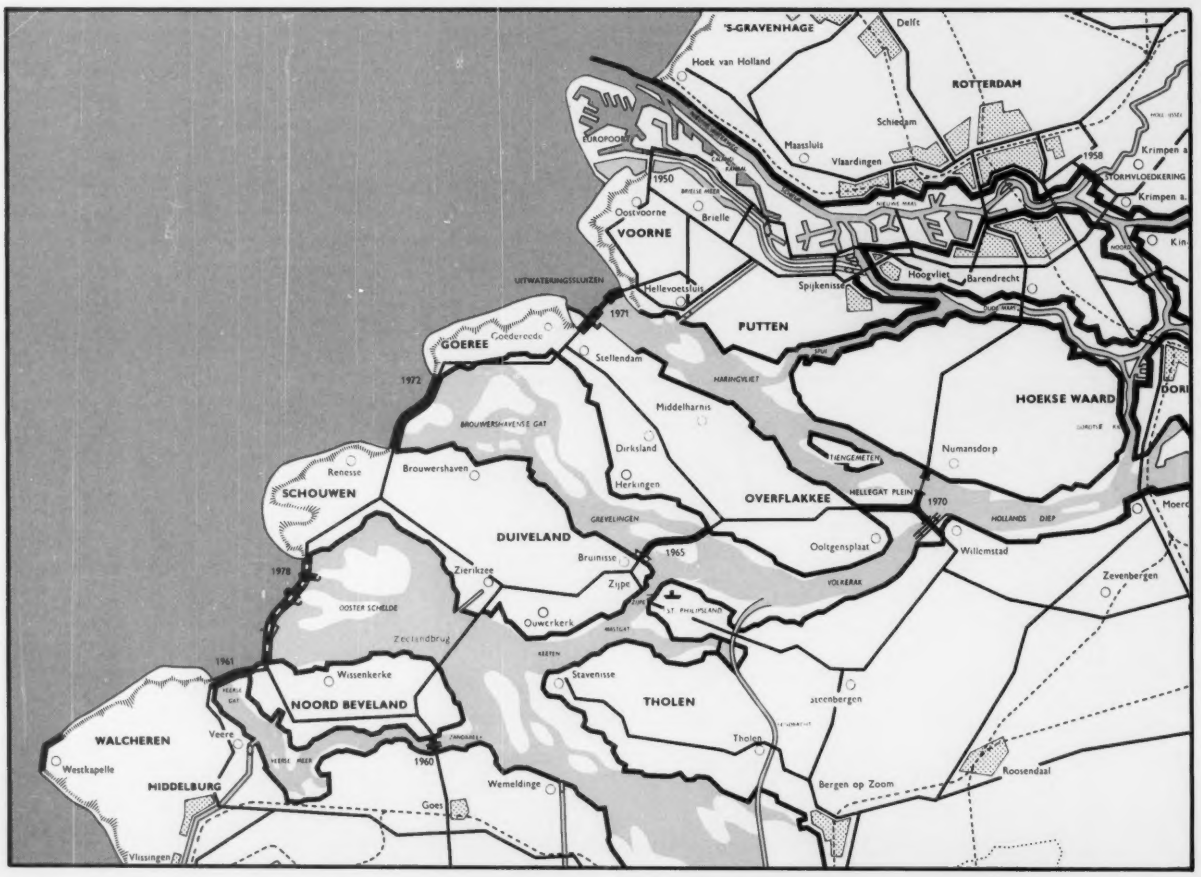
Governmental and private enterprise responded with plans that included provisions for water resource development. Utilization of the resources of the Rhone River and its tributaries was improved for the benefit of inland navigation and supporting ocean facilities, the production of electrical energy, and the supplying of water for communities and enhancement of agricultural output.

Under this plan, certain uses—such as irrigation—could not pay for water at prices acceptable to industry and municipalities, yet irrigation was essential to success of the plan. Therefore negotiation, rather than use of rigid formulae, became the basis for sharing project costs among the farmer, the processor, industry, the community, the shipper and the receiver.

The result appears to be that more goods, but fewer rural people, move to the already crowded cities; the improved economy and ecology benefit man and nature.

In a discussion with the Swiss delegates, one learns how national, regional and local interests were accommodated while undertaking a vast transbasin diversion of water. The central government negotiated with the near-autonomous Swiss cantons for permission to tunnel through the near-pristine mountains so long as the government did not despoil their natural beauty. Today crystal clear mountain waters and pollution free electric power flow westward from valley to valley into Lake Constance while the water "rentals" flow eastward. From the international shorelines of Lake Constance, another diversion, by pipeline, reaches as far as Stuttgart, Germany.

Ongoing construction of Dutch Delta Works slowly dams southwestern estuaries, bringing economic and social changes.



National water policies, international interests and jointly conceived development make interesting topics of discussion with delegates of other nations as well. A case in point is the proposed linking of the Rhine River to the Danube, via the Main and a canal system. Construction of this link involves German, Austrian, Hungarian, Yugoslavian and Romanian authorities, prompting one to ask: Considering that railroads and highways already link those nations, should transportation via waterways also be fostered?

Data describing monetary benefits and costs, especially when the future is discounted at high rates of interest, provide but pieces of the full answer to that question. Other pieces must be obtained from the social, political and environmental requirements of national policies. These may transcend the benefit/cost (B/C) ratio, which has been used in the United States, for a *go* or *no-go* decision. Deciding when and where to subordinate the B/C ratio to other nonmonetary factors concerning a major water development is a governmental process in which economists are not necessarily the chief architects.

A final example of the insights we can receive from another government's water policies is illustrated by the Dutch Delta Works. Many Americans understand the basic Netherlandic need to claim lands from the sea for flood control and navigation. When confronted a decade and a half ago with massive flooding that inundated dyked land, the Netherlands considered the extent to which the future improvement of such works should include agricultural, industrial and community development. Should works be enlarged where incremental returns would not repay both the incremental costs and a share of joint project costs?

The answer lay more in the aims of the government and less in arithmetical formulae. As with certain irrigation projects in South France, land and water used for agriculture by the Netherlands is developed on the basis of estimated ability to pay. Also, the direct beneficiaries of flood control and navigation developments (the owners of ships and barges) are not directly levied the full costs of the Delta Works. Instead, the Dutch nation helps to pay much of the cost, since the nation also gains whenever the viability of enterprise is enhanced.

Understanding of overseas governmental practices may be helpful in setting our own water development policies. One example: our forecasted needs for greater mineral and oil imports will require higher levels of exports from foreign countries. Their degree of com-

Ice breaking on the Rhine typifies a navigation problem common to many PIANC member nations.

Switzerland's transbasin diversion scheme required tunneling through rugged alpine terrain such as this, while preserving its scenic beauty, in order to let mountain waters flow from valley to valley.

Proposed linking of Rhine and Danube, via the Main River and an interconnecting canal, will call for international negotiations among navigation policy experts.

petitiveness, however, will be influenced in part by governmental water policies relating to navigation, flood protection, energy, agriculture and the productive capabilities of their communities.

Formal PIANC Outputs

The established outputs of PIANC respond to the needs of the members, based on PIC evaluations. Examples include a six language dictionary of terms applicable to facilities for ports and waterways, a manual on dredging techniques, and standards relating to containerization and the handling of petroleum and its products.

Five PIANC commissions are currently at work in these areas:

- sports and pleasure navigation
- waves
- environmental effects of dredging and the disposal of dredged materials
- locks, ship lifts and river weirs
- reception of large ships

The commission on waves has published a draft report incorporating advanced techniques for evaluating wave effects on vertical, composite and sloping surfaces of differing compositions. This has received considerable attention among PIANC members.

The commission on large ships, whose earlier works received widespread attention, will produce a new work likely to include:

- advanced methods for minimizing oil pollution
- offshore *islands* for large ships
- reanalyses of physical factors influencing use of fairways by large ships.

The study of dredged or fill materials is examining pollution standards, current research on and beneficial uses of dredged material.

Recreational uses of waterways have been the subject of additional reports by PIANC groups.

In all commission work, PIANC coordinates with other international organizations which have related or overlapping interests. This includes the United Nations, as well as specialty organizations.

Information on publications and the work of PIANC committees may be obtained from the secretary of the American section,[2] who is also a source of information on the September 1977 PIANC congress in Leningrad.

The quadrennial congresses of PIANC serve to focus international interest on the various uses of water—primarily navigational—in pursuit of national aims. While each member nation functions independently in terms of its own policies, the international exchange of views and information mutually benefits the national governments represented. The success of this concept has kept PIANC a viable international organization whose recommendations influence the future use of navigational facilities to enhance national aims and improve international relations.■

[2] Secretary, U.S. Section PIANC
The Resident Member
The Board of Engineers for Rivers and Harbors
The Kingman Building
Fort Belvoir, Virginia 22060

After an 8-year study of the American Falls at Niagara, the International Joint Commission (IJC) has decided to let nature take its course. The IJC, which deals with areas of common concern to the United States and Canada, recently recommended that nothing be done either to preserve or enhance the beauty of the American Falls.

The consensus was that, in about 2,000 years, the natural process of erosion will have eroded the Horseshoe Falls so far upstream along the Niagara River that the American Falls, between Goat Island and the U.S. mainland, will no longer exist.

The study grew out of thinking that stopping erosion of the rock face and cleaning up the talus —or loose rock—at the foot of the falls would preserve the American Falls for posterity.

In the spring of 1969 the IJC's American Falls International Board took the unprecedented step of requesting the U.S. Army Corps of Engineers to cut off the flow of water to the American Falls in order to survey the condition of the rock face under the falls. A giant earthen and rock cofferdam was constructed upstream to dewater the falls as photographers flocked to the scene to capture this historic moment on film. The first to photograph the exposed rock face was a Niagara Falls, N.Y. photographer, whose accompanying photo adventure grew out of his daily visits to record this historic tampering with nature.

by Herbert C. Force
Niagara Falls, N.Y.

THE FACE BEHIND THE FALLS

Buffalo District

First construction of the cofferdam began Monday, June 9, 1969, and I was there from that day forward, spending most of the mornings and early afternoons photographing the construction of the 80-foot wide and 570-foot long cofferdam.

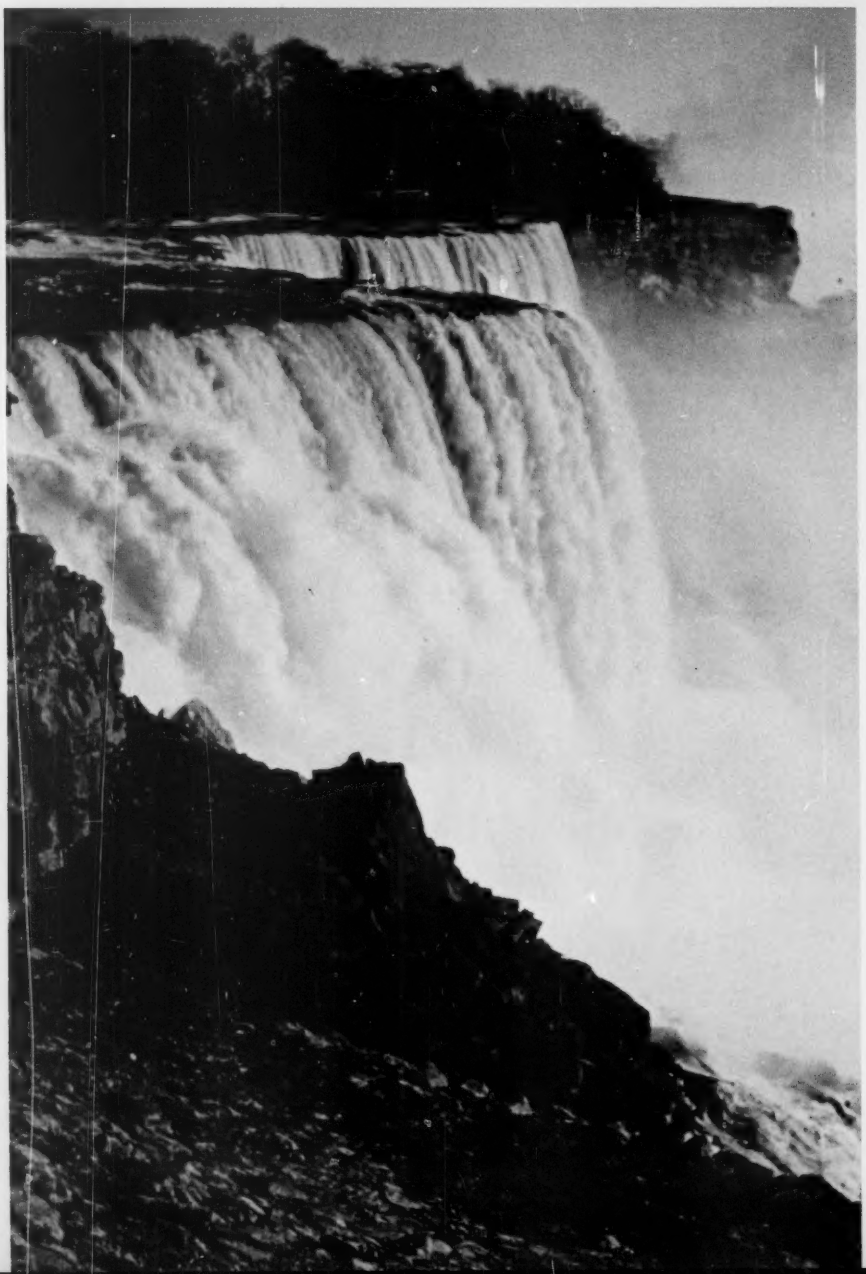
Wednesday morning, June 11, work came to a halt at 10 a.m. because the dirt fill was being washed away by the extra swift current. Big rock boulders were being dropped into position by 11:15 a.m. as dump trucks backed within feet of the fragile cofferdam bank to unload. I hated to leave the scene at 2:30 p.m. for my regular work assignment while the big battle to halt the swift current continued.

After work I rushed down to Prospect Point for some night photos, arriving just before the white lights came on at 11:45 p.m. Almost all the 25,000 tons of earth and rock making up the cofferdam were in place. It was a warm evening and many others were present to witness this once in a lifetime sight.

By now there was not much water flowing over the cataract, and I noted something strange projecting from the western tip of the precipice where the upstream waters parted. Being the only one with a camera on a tripod, I took advantage of a few open spots along the railing to shoot as many time exposures as I could at f/5.6 before the lights were turned off—bracketing this f-stop between 15 and 45 seconds on ASA-64 film to compensate for the uncertain night lighting conditions. It was not until much later, after I had received my color slides of that night's photos, that I realized what I had

Traditional view of American Falls before Niagara *fell silent on two separate occasions.*

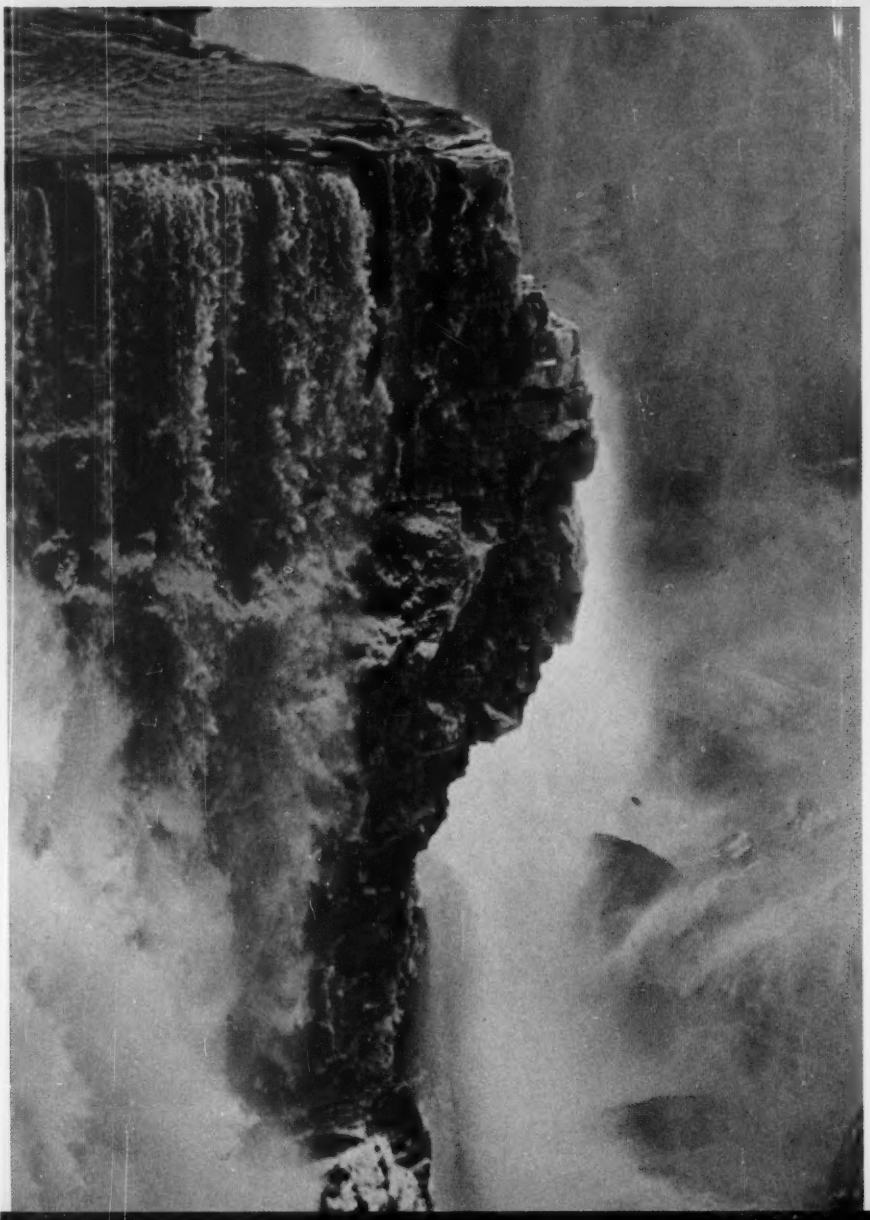
Next page—First view of Indianhead on face of dewatered American Falls taken under white night lights 5 minutes before midnight June 11, 1969. Color shifted to red using Ektachrome ASA-64 film.



© Herbert C. Force 1970

Next day's view of dewatered American Falls shows profile of Indianhead rock formation.

Ice jam slowed volume of water flowing over American Falls in April 1970, again revealing Indian rock face with red and white plywood marker left behind from 1969 survey.



Author obtained orange tint by sandwiching blank piece of Kodacolor negative between overexposed Ektachrome views.

captured on film for posterity—a profile of an Indian head.

The sudden darkness brought sadness. Many wished the lights could have remained on all night for this historical event. Many outstanding shots could have been made as the flow of water progressively decreased.

I was back at the same spot at 8:45 a.m. on Thursday morning, June 12, for my first daylight photography of the now almost dewatered cataract. I found people standing at the railing just gazing in awe at this unbelievable sight—one that even Father Louis Hennepin, the first non-Indian visitor to Niagara in 1678, never saw. The last rock fill was in place by 10:30 a.m. that morning, marking the first time man's tinkering had shut off the 4½ million gallons of water per minute that normally poured over the American Falls.

By then many amateur and professional photographers were taking daylight views of the mighty Niagara in the *nude,* revealing to the world the Indianhead natural rock formation. Through my knowledge of night photography, I had obtained the first views of this phenomenon the previous evening. As a result of the dewatering, this Indianhead formation became one of the main tourist attractions until the rewatering of the American Falls on November 25, 1969.

Not to be outdone by mere man, Mother Nature duplicated the earlier engineering feat hailed round the world in 1969 as a once in a lifetime opportunity to see a denuded American Falls. On Thursday, April 9, 1970, a giant ice jam at the head of Goat Island reduced the flow of water coming down the American channel by about 85 percent. As the majority of the waters diverted to the Horseshoe Falls, the Indianhead again came into view. This rare spectacle lasted only a brief 3 days. On April 11, 1970—that Saturday evening—the ice jam broke up, releasing a stream of water over the cataracts.

This time the Indianhead may be hidden, perhaps forever. Engineers say a rock collapse is imminent at this point of the precipice, the weakest part of the American Falls. Millions of pictures have been taken of Niagara Falls—one of the seven wonders of America and the world—but the challenge in photographing the majestic cataracts is the dream of capturing something different, such as that fantastic Indianhead profile.

An item of passing interest at the time of the first dewatering was the recovery of $25 in pennies by workmen from the Niagara Frontier State Parks Commission, who confirmed the presence of at least a few "Indianheads" among those in the 12-quart pail of pennies they collected.■

An international photographer, Mr. Force is a member of both the Cataract Camera Club of Niagara Falls, N.Y., and the Niagara Falls Camera Club of Ontario. He is also publicity chairman for the Niagara Frontier Regional Camera Clubs, an organization of nine clubs located in Canada and the United States.

Events, Deeds & Deliberations

Films

"The New Willamette," a U.S. Army Corps of Engineers film, recently received the Golden Eagle Award from the Council on International Nontheatrical Events (CINE) at its annual awards ceremony in Washington, D.C. The Golden Eagle Award is given to films selected as being worthy of representing the United States in overseas film festivals. "The New Willamette" will be shown at competitions in Italy, Czechoslovakia and Portugal.

This 26-minute color film is available to the public and can be obtained from any Corps division or district Public Affairs Office.

"The New Willamette" describes the cleaning up of the once severely polluted Willamette River in Oregon through the cooperative efforts of citizens, industry, local government and the Army. This experience of the Willamette—12th largest river in the country—demonstrates how a major river can be restored to a condition clean enough to permit swimming.

Three other color films, produced by the Corps in 1975, are also available to the public at any Corps division or district office.

"Walking On A Miracle," 14 minutes long, depicts the land treatment system in operation at Deer Creek Lake, Ohio. This is the Corps' principal demonstration project site for the use of land treatment to purify wastewater.

"A Whole Lot Proud" tells the story of the park rangers employed by the Corps of Engineers to manage more than 400 Corps lakes used for recreation. Lasting 25 minutes, it was filmed in the panoramic Ozarks, the rugged hills of South Dakota and the beautiful terrain of Tennessee.

"We Were There, But Not for Conquest" is a 28-minute depiction of the role of the U.S. Army Corps of Engineers in the development of the United States. This film, which covers the Corps activities in the years between 1775 and 1975 in both peace and war, shows the contributions through 200 years. ■

The Coastal Society

Dedicated to the promotion of knowledge, understanding, and wise use of coastal environments, *The Coastal Society* held its first annual conference November 24-26, 1975 in the Washington, D.C. metropolitan area. The theme of the 3-day conference was a holistic and interdisciplinary approach to coastal service, planning, and decision making, and included presentations on case histories of coastal planning and management, coastal legislation, offshore oil problems, coastal environment impact assessments, and the importance of coastal resources to future food and energy needs. Memberships in this new society are available to persons involved or interested in coastal activities by contacting the society at P.O. Box 34405, Bethesda, Md. 20034. ■

Insects Are Not Litterbugs

A reader has taken issue with the sign in this photo which appeared in our Fall 1975 *Water Spectrum* in a story by Dr. J. W. Shiner about "Managing Outdoor Recreation Resources." Bryant Mather of the Corps of Engineers Waterways Experiment Station at Vicksburg, Miss. reminds us that certain insects have been proposed for listing as endangered or threatened species. He writes:

"I think you can see why the theme intended by the illustration has a secondary meaning that is quite seriously contradictory to the major theme of your publication. I write as an employee of the Corps who is also, as a citizen, interested in butterflies."

We concede Mr. Mather's point and in future will try to be more sensitive to the status of our crawling, flying friends. Definitely, litterbugs should be restricted to an ecological group all their own. ■

The River Academy

Reprinted with permission of the Wall Street Journal © 1975 Dow Jones & Company, Inc. All rights reserved.

Now, Boat Pilots Are 'Learning the River' Strictly by the Book

Mark Twain Would Shudder, But to Get a License, Cadets Go to Classes at an Academy

By Robert L. Simison
Staff Reporter of The Wall Street Journal

ABOARD THE MARK EASTIN—Squinting and frowning slightly, Donny M. Ferguson leans forward in the pilot's chair as he carefully manipulates the towboat's rudder bars to push its 15-barge tow under the Shawneetown, Ill., bridge. Responding to the pilot's warning to watch out for rocks, he makes one last adjustment, then squares the boat's rudders. The Mark Eastin passes another obstacle on her trip up the swirling, muddy Ohio River.

Mr. Ferguson, who three years ago was flying executive charter jets for $15,000 a year, is one of the first graduates of the new National River Academy. Now, as a steersman, he is gaining the final experience that will land him his coveted license as riverboat pilot.

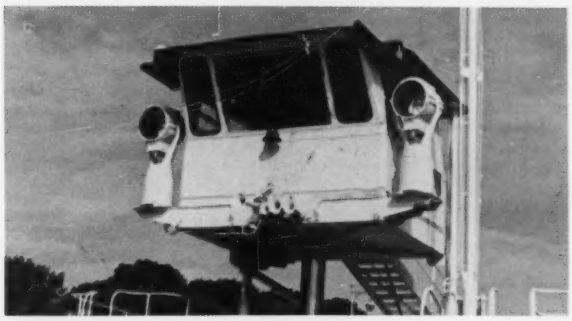
As long as anyone can remember, riverboat pilots have "learned the river" exactly as Mark Twain did

more than a century ago, picking up the secrets of the profession slowly over four or five years from experienced pilots. But faced with a shortage of pilots in the rapidly expanding industry, towing companies are turning to formal, faster training for pilots. Five years ago, a group of 14 companies involved in the river industry founded the nonprofit National River Academy, the first and only of its kind. The cadet program began two years ago.

New Ways Supplant the Old

"The old way of learning by doing is no good anymore," says Pierre R. Becker, a retired U.S. Navy captain who is superintendent of the academy. One development that hastened this conclusion was passage of a 1972 federal law requiring licensing of towboat operators on the nation's 23,000 miles of inland waterways.

The new academy, located on the banks of the Mississippi 10 miles downstream from Helena, Ark., offers prospective riverboat pilots a 22-month course consisting of two-month sessions studying at the academy alternating with equal stints working on some of the nation's 4,000 towboats. They get training in basic deckhand work (cable throwing, tank-barge handling), as well as engineering, navigation, maritime law and actual piloting. Graduates qualify for second-class operators' licenses as steersmen, which, after a one to two-year stint, lead to pilot's certificates. Cadets pay



$1,250 tuition a year; sponsoring companies ante up an additional $2,700. For this, they also get their room and board.

The river, of course, is home to many of the academy's cadets, and coming here to expand their knowledge and expertise is a natural step. "I guess that river water is in my blood," drawls Henry Cummings, 19, of Biloxi, Miss., who figures his family has about

150 years of tradition on the Mississippi.

But the academy is also attracting to the river those who probably wouldn't endure the customary three years as a deckhand to get a shot at becoming a pilot. Paul Swenson, for one, was a custom-home builder in Woodstock, N.Y., before joining the class that will graduate next August. "I like fresh air and working outside, and this is a lot more stable," the 24-year-old cadet says.

Ticket to Steady Work

Another who plans to use his academy training to change careers is Stephen H. Turner, a Gretna, La., mechanical engineer. He plans to leave an American Bureau of Shipping job as a $15,000-a-year structural analyst to enroll in the school this May. "I got tired of working in an office, watching the boats go by on the river," explains Mr. Turner, who is 31 and has a wife and child.

Most cadets see the river pilot's license as a ticket to a steady, well-paying job that is more interesting than most. Indeed, there is continuing demand for their skills. Capt. Becker estimates more than 300 new pilots are needed each year—far more than the 20 to 30 the academy turns out. Experienced pilots are paid $15,000 to $25,000 a year, plus free room and board on the boats. Mr. Ferguson, the former charter pilot, says, "I dearly love aviation, but I'd gone about as far as I could as a jet pilot, and there wasn't any job security there." As a steersman, he makes $10,000 a year, compared with an estimated $20,000 if he had continued flying. He is confident, however, that in the long run he'll earn more and have more permanent work on the river.

While the new school has won praise from cadets and towboat companies, some veteran rivermen remain skeptical. "You can't make a pilot at a school," one old hand says with a snort.

For romantics who visualize the riverboat pilot's life as a continuing travelogue of lazy waters, beautiful scenery and picturesque people, the hard facts of life come as a sobering surprise. For one thing, piloting requires vast knowledge of the river and considerable finesse. The Eastin, herself 178 feet long and 43 feet wide, normally pushes a "tow" of 15 barges lashed together to form an unwieldy vessel 1,000 feet long and 105 feet wide. Spring storms can turn the usually tranquil river into a swollen, rolling flood that can propel the ponderous vessels downstream at a treacherous 15 miles an hour. At such times, pilots have little chance to correct even minor errors. "There

are moments of stark, raving terror," Mr. Ferguson admits.

The profession also demands a special devotion. Rivermen normally work 30 days at a time, then take 15 to 30 days off. Mr. Ferguson, on an unusually long stint, is in his 33rd day of working six hours on and six off. He won't get off the boat for 15 more days, the time it takes the boat to travel up to Louisville and back down to Paducah, Ky. "It wears on you," admits Mr.

When the well's dry—we know the worth of water.
Ben Franklin

Ferguson as he wearily sips a cup of coffee during the midnight-to-6 a.m. watch.

There are some amenities, however. The Eastin's full-time cook (the only woman among the 14-member crew), prepares three sumptuous meals a day. "The food's always good on the river," says a grimy, grinning deckhand gobbling a hunk of strawberry shortcake. Except for the aguelike shudder that the Eastin's 5,600-horsepower diesels constantly send through the decks, the living quarters might well be on dry land. Mr. Ferguson sleeps in a bed and showers with hot water.

Relaxation along the way is confined mostly to watching television and reading Western novels. The Eastin's captain, Jay Supple, often ducks out of the pilothouse to join off-duty deckhands in a game of stud poker. And of course, the ever-changing scenery provides another diversion. On this trip, however, all that can be seen is a monotonous expanse of brown water broken only by treetops and isolated houses.

"There's a lot of boredom, and I'm too old to find all this romantic," concludes the 31-year-old Mr. Ferguson. "But I believe I made a wise decision."■

Starving Algae

Aluminum sulfate, commonly known as alum, has been tested with considerable success in reducing the growth of algae in a fresh water lake, according to a team of researchers from Kent State University in Ohio.

Team members spread aluminum sulfate over the surface of a 2½-acre lake near the Kent campus. They found that the phosphorus in the lake was attracted to the sulfate, forming a transparent jelly-like floc that subsequently sank to the bottom. According to the researchers, formation of the floc prevented the phosphorus from reentering the water, which reduced the growth of the algae.

A zirconium compound is also being eyed as a potential agent for cleaning up the Nation's lakes. Environmental Protection Agency scientists who tested the substance found it reduces unwanted phosphorus and growths of algae in lakes.

Like aluminum sulfate, when added directly to water the compound combines with phosphorus and settles to the bottom, where it is out of reach as an algal nutrient.

Zirconium is plentiful enough to make it practical for use in lake restoration, the scientists suggest, since it is available in quantity from certain varieties of beach sand.■

Fish Join Work Force

If research by biologists in the Environmental Protection Agency's laboratory at Duluth, Minn., pans out, a lot of unsuspecting fish may be hooked into the chore of registering complaints about the level of water pollution. In a sense, the fish will be subjected to an invasion of privacy because a monitor will make a polygraph record every time they cough. As the level of pollution rises so does the frequency of fish coughing to clear the pollutant from their gills. Application of the technique may be within reach for industries to measure pollutants in their industrial outfalls.■

A People Project

There are 72 extra U.S. Army Corps of Engineers employees at the Lake Mendocino recreation area who would not have been there if Title X of the Public Works and Economic Development Act had not been passed. Located 3 miles north of Ukiah, Calif., the Lake Mendocino area has been the recipient of improved hiking trails, picnic shelters, barbecue pits, wheelchair ramps for public restrooms, steps and handrails at fishing spots and an endless list of other small improvements. Those eligible for this Title X employment project were identified by the local State employment office from among unemployed residents of Mendocino County.■

Weeding Out Wastewater

Water hyacinths, one of the most prolific water weeds in the Southeast, may have some redeeming qualities after all. Dr. B. C. Wolverton of NASA's Space Technology Laboratories at Bay St. Louis, Miss. is investigating the use of water hyacinths on sewage lagoons and ditches for renovation of wastewater. Thus far, application of aquaculture as a form of treatment indicates good nutrient and heavy metal removals by the water hyacinth plant.

To maintain an effective continuing process for renovating wastewater, however, Dr. Wolverton found that it was necessary to harvest each crop before the plants became fully grown. The fact that the water hyacinth can produce about six "crops" a year in this country's southeastern climates led to other useful information about this weed.

One method of harvesting being tested chops up the plant and anaerobically digests it, producing a high grade methane gas at an annual rate of about 1 million cubic feet an acre. The second method air dries the harvested plant, then grinds it for use as experimental livestock feed.

Both methods apply the concept of resource recycling as part of a system approach to aquaculture treatment of wastewater.■

What Is A Wall?

by Bruce A. Sossaman
Chief, Public Affairs Office
New Orleans District

The world is full of walls. They provide privacy, protection from unwelcome intruders—and unwanted sounds—visual appeal within aesthetically pleasing settings, or flood protection. Seldom, though, does any one wall meet all these needs.

Perhaps that is what makes the Dumaine Street Floodwall, in the heart of New Orleans' *Vieux Carre,* so distinctive. It is a part of the scene rather than an intruding structure.

When the Vieux Carre Commission began planning to restore the historic French Market area, the New Orleans District of the Corps of Engineers worked closely with the commission. The restoration project incorporated the wall, constructed in 1953, without compromising its purpose as a flood protection structure for this low-lying area of New Orleans.

Over 20 years later, the rewards of the joint venture are visually evident today in a floodwall that not only guards the picturesque French Quarter from the Mississippi's periodic flooding, but also shields the quaint French Market environment from the sights and sounds normally associated with the existence of an adjacent railroad siding. ■

Photos by Eddie Lewis

WATER SPECTRUM, WINTER 1975-76

A Helicopter Approach To The Environment

Never before in the history of the Alaska District of the Corps has a request for bids included the condition that all construction transportation be by helicopter. Although some past contractors preferred using choppers over ground transportation, the contractor on this project does not have that option.

The airborne requirement is meant to protect the environment of a national forest through which the Corps has asked permission of the U.S. Forest Service to relocate 6 miles of transmission line. The problem section of the existing line now runs along Salisbury Ridge between the Snettisham hydroelectric plant and a substation at the capital city of Juneau in the southeastern Panhandle of Alaska. Salisbury Ridge, however, is too exposed and when gale winds extensively damaged the line during the early part of 1974, the Alaska District began to investigate alternate routes at a lower elevation, along a more protected path.

Working with the Forest Service in this heavily wooded area of Alaska, the Corps selected a new route through the Tongass National Forest roughly paralleling Gastineau Channel. In return for permission to relocate the 6 miles of transmission line within a national forest, Corps personnel had to agree to certain forestry practices designed to preserve the forest environment.

Foremost among these is the requirement that the tower installations follow the contours of the natural topographic benches in order to place the transmission line beyond the line of sight of Gastineau Channel travelers. In addition, the towers must be painted dark green to blend into the forest background and only dull finish conductors may be used to reduce visibility.

The contractor will also be expected to hold the right-of-way to minimum width by cutting as few trees as possible, preserving the small trees and leaving intact the forest root structures—all to prevent soil erosion. A *taper* clearing technique will be used by contract loggers, who will feather the timber cutting and trimming outward as well as upward in a continuing V-cut as they proceed. Furthermore, all blowdowns will have to be removed periodically to keep the right-of-way from becoming unsightly, according to the contract.

It is obvious the contractor not only will have to face the often frustrating weather conditions of the Alaskan Panhandle but also the challenge of causing minimal disruption to the environment.

Colonel Charles A. Debelius, Alaska District Engineer, anticipates his making airborne transportation part of the contract will require the contractor to use choppers to airlift loggers in and the cut timber out. Air mobile crews also will have to be employed to bring in equipment and supplies, prepare the foundations for and erect the towers, string the line, connect the conductors and test the line.

Much joint planning with the Forest Service preceded letting of the construction bids, which were opened in February. Part of this planning effort extended even to the identification of all eagle nests along the proposed relocation route to insure that construction flights are planned to avoid these bird habitats.

The rewards of considering the environment as well as the requirement to protect the power supply to the city of Juneau will be evident by mid-October 1976, when construction of the new line is scheduled for completion. ■

Coming Events

Annual Recreation Management Institute, sponsored by Department of Recreation and Parks, Texas A&M University and National Park Service, at College Park, Tex., March 29-April 1.

Government Affairs Seminar, Water Pollution Control Federation, at Washington, D.C., April 6.

International Symposium on Hydrologic Problems in Karst Regions, Western Kentucky University, at Bowling Green and Mammoth Cave National Park, Ky., April 26-29.

League of Women Voters National Convention, New York, N.Y., May 3-7.

Docks and Marinas, University of Wisconsin-Extension program, at Madison, Wis., May 4-5.

Fundamentals and Applications of Minicomputers and Microcomputers, Center for Industrial and Institutional Development, at University of New Hampshire, Durham, N.H., May 24-28.

Summer Institute in Water Pollution Control at Manhattan College, Bronx, N.Y., May 24-28.

Outdoor Writers Association of America National Conference at Snowmass, Colo., June 20-24.

Industrial Wastewater Control course at Department of Environmental Engineering, Cornell University, Ithaca, N.Y., July 5-9.

International Conference on Finite Elements in Water Resources, sponsored by National Science Foundation and U.S. Geological Survey, at Princeton University, Princeton, N.J., July 12-16.

Izaak Walton League National Convention, Baltimore, Md., July 14-17. ■

DAEN-CWM-P
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

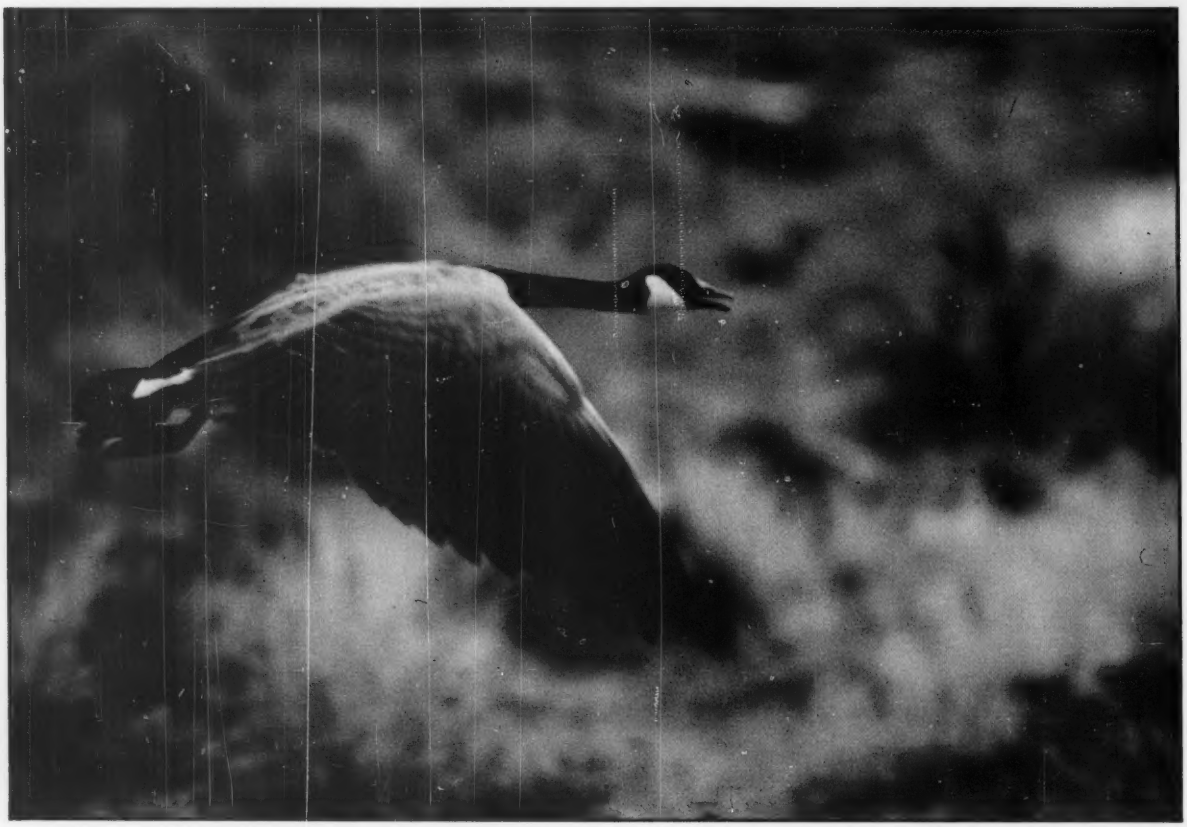
OFFICIAL BUSINESS

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DoD-314

U.S.MAIL

THIRD CLASS BULK RATE

R 1
WASP XEROX300XB
XEROX UNIV MICROFILMS
SERIALS DEPT
300 N ZEEB RD
MI 48106

ADDRESS CORRECTION REQUESTED
Forwarding and Return Postage Guaranteed

This Canada goose was flushed from its nest during annual survey of goose production in mitigation areas. See story on page 7.